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E. J. Harwick.
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U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
ANIMAL HUSBANDRY RESEARCH DIVISION
and
COOPERATING WESTERN STATES

W-1 - IMPROVEMENT OF BEEF CATTLE THROUGH THE APPLICATION OF

BREEDING METHODS

1959 Annual Report of W-1

and

Report of

Annual Meeting of Technical Committee

Corvallis, Oregon

July 8-9, 1959

This report is intended for the use of
administrative leaders and workers and
is NOT for general publication.

Animal Husbandry Research Division
Beef Cattle Breeding Research
312-B New Custom House
Denver 2, Colorado

ANNUAL MEETING
W-1 Technical Committee
Corvallis, Oregon
July 8 - 9, 1959

Ralph Bogart, Chairman

Project Leaders Present:

Arizona	O. F. Pahnish
California	W. C. Rollins
Colorado	H. H. Stonaker
Hawaii	E. H. Cobb
Idaho	R. E. Christian
Montana	F. S. Willson
Nevada	D. W. Cassard
New Mexico	L. A. Holland
Oregon	Ralph Bogart
Utah	J. A. Bennett
Washington	C. C. O'Mary
Wyoming	P. O. Stratton
U. S. Range Livestock Experiment Station	R. R. Woodward

Regional Administrative Adviser S. S. Wheeler

Western Regional Coordinator R. T. Clark

Agricultural Research Service:

Animal Husbandry Research Division
Chief, Beef Cattle Research Branch E. J. Warwick

State Experiment Stations Division M. J. Burris

The meeting was called to order at 9:00 A.M., July 8, by Dr. Ralph Bogart, Chairman. Two new committee members, Dr. L. A. Holland of New Mexico, and Dr. D. W. Cassard of Nevada, members of the host institution, and guests were introduced.

Dr. Bogart:

Oregon State College in the animal work has enjoyed a lot of privileges and opportunities. We feel a great deal of credit for this is due to our administration. So we thought it was only fitting to ask Dean Price to meet with us, and we have asked him to give a word of welcome to the group.

Dean Price:

It is a real pleasure to welcome the W-1 Committee to Oregon State College for your official meeting of 1959. W-1 means a lot when you look to the history of the development of our regional project work. You did not even

wait for regional funds to be laid out on the line. You were organized before funds were available.

It has been an interesting experience for all of us to go through the pattern that regional research has brought to us. At first it seemed that the principal thing we were doing was spending money for travel. It was the most conspicuous thing that was coming out of the work.

The development over these years since 1946 has brought to the experiment stations of this country a coordination and cooperation in the development of research that nothing else has ever been able to bring to them. It has provided funds to bring together technical workers working in one area. The work is scrutinized by the Committee of Nine, and State Experiment Stations Division make their contribution to see that we are doing the job we should do. So, altogether we have several forces at work trying to develop this new pattern of research. It has brought to the professors and scientific workers a type of exchange of information, a type of constructive criticism, that I doubt we ever had before. I have seen some of the committees working. They settle down and do a real job of constructive analysis and offer suggestions to each other. Others are afraid of speaking to each other, have not warmed up to the job yet. I have seen some enthusiastic committees working together and after they catch on all appreciate it. I don't think anybody is so good in our research but what he could profit by listening to his colleagues. Too often we are too close to our own job to see it clearly and if we can accept the suggestions made by others it is helpful.

It is a marvelous program, and I think we have made real progress. The directors have had a new experience working as Administrative Advisers to these regional research projects. Some of the committees may feel that the directors get pretty far afield, but we are pleased to have had an active part through our specialized staff in W-1. You have amazed us with the publications you have brought out of this work and with the number of stations participating in the regional project. The interest is keen. It is a real pleasure to welcome you.

Dr. Bogart introduced Dr. Li, who spoke to the Committee on "What does statistics do for the research workers?" A summary of his remarks follows:

The objective of all research workers is to increase knowledge. They accomplish this by two different methods; namely, deduction and induction. Mathematics is the technology of deduction, while statistics is that of induction.

Experimental scientists in all fields gain knowledge through experimentation. The data they produce are the records of their observations of a limited number of objects, such as animals and plants. They do not merely describe these data, but they also try to reach general conclusions from the data. This process of gaining knowledge is induction, the tool of which is statistics. It might be said that statistics is

the tool which is used by experimental scientists to reach general conclusions from their data.

Statistics is a new science. The number of methods available to the experimental scientist is still quite small. Because of this, it is important for the experimental scientist, before he starts on his experiment, to check with a statistician to make sure that a method is available to analyze the data; that is, to reach conclusions from the observations made on a limited number of objects.

Dr. Bogart then called for station reports, which were given by the project leaders alphabetically by states, as follows:

UNIVERSITY OF ARIZONA

I. Station: Arizona Agricultural Experiment Station, Tucson, Arizona

II. Project Title: Breeding and selection of beef cattle for the Southwest

III. Personnel:

Experiment Station:

O. F. Pahnish, C. B. Roubicek, E. B. Stanley, A. M. Lane,
and E. S. Erwin

Graduate Students:

R. H. Diven
N. G. Elliston
H. M. Page
R. E. Taylor

Cooperators:

Empire Ranch, Sonoita, Arizona
Arivaca Ranch, Arivaca, Arizona
Apache Indian Agency and Apache Tribe, San Carlos, Arizona

Montana Agricultural Experiment Station, Bozeman, Montana
Wyoming Agricultural Experiment Station, Laramie, Wyoming
U. S. Range Livestock Experiment Station, Miles City, Montana

U. S. Department of Agriculture:

R. T. Clark, Coordinator
C. E. Shelby

IV. Nature and Extent of Work Done This Year:

A revised project plan including all phases of the breeding research program conducted on the Empire and Arivaca Ranches and in the Apache Tribal Herd was submitted to the members of the W-1 Technical Committee for consideration.

Material for inclusion in revised line project was submitted to the Regional Coordinator, Dr. R. T. Clark, prior to the due date (April 1, 1959).

A review of prior work to be included in the proposed Regional publication has been submitted to the Regional Coordinator.

Empire and Arivaca Ranches

The accumulation of performance data as outlined in the Arizona project was continued. These data are being consolidated for analyses of genetic

and environmental influences on postweaning traits and for further evaluation of the influences on preweaning traits. Results of the analyses of preweaning data over a period of six years were presented in the last annual report.

Apache Tribal Herd

The breeding project conducted in cooperation with the Apache Tribe at San Carlos, Arizona, was continued under the provisions of a memorandum of understanding signed in 1955 and a supplemental memorandum signed in 1957. Birth dates and weights are recorded. The following data and samples are obtained at weaning time and at approximately 12, 18, and 24 months of age.

1. Weights, conformation scores, and condition scores
2. Liver samples
3. Blood samples

The liver and blood samples are analyzed quantitatively for the following constituents:

Liver	Blood	
Vitamin A	Vitamin A	Uric acid
Carotene	Carotene	Hemoglobin
Copper	Calcium	Glucose
Iron	Phosphorus	Creatinine
	Total protein	Total cholesterol

To date, information on relatively unselected bull and heifer calves produced in 1957 (the progeny of 9 sires) has been collected through 24 months of age. Data on bull and heifer calves produced in 1958 (the progeny of 9 sires) have been collected through 12 months of age. The chemical analyses of all blood and liver samples collected to date have been completed. All data have been recorded for IBM processing and preliminary statistical analyses are in progress.

During the current breeding season 12 sires, each with a complement of 25 to 30 cows, are in use. Two sires were obtained from each of four Miles City lines (1, 6, 9, 10) and the others, unrelated to the Miles City lines, were produced in the Apache Tribal Herd and were selected by the usual visual method. The unselected heifers produced in 1957 were allotted at random within sire to two bulls raised in the Apache Tribal Herd. This will provide an initial test of the productivity of females sired by six Miles City bulls and three bulls raised in the Tribal herd. All other sires received cows allotted at random within age of cow.

V. Summary of Progress and Conclusions to Date:

The calving percentage (live calves born/cows bred or calves weaned/cows bred) has increased progressively since the program was initiated. These percentages are shown below:

Year	Percent at Birth	Percent at Weaning
1957	68	62
1958	74	68
1959 (Preliminary)	82	-

The increases in the calving percentages are attributable in part to the removal of cows that were inconsistent breeders and to the appraisal of bulls on the basis of semen evaluations prior to the breeding seasons. In addition, the use of smaller breeding pastures in which a reserve supply of forage is allowed to accumulate for the breeding season is believed to be a contributing factor.

Application of Findings

The increase in the calving percentage in the Apache herd while the research program has been in progress has provided an opportunity for the collection of more research data or for increases in subclass numbers to be used in the statistical analyses of the data collected. The improvement in calving percentage is also of practical importance. In comparison with the calf production records in the first year of the program (1957) or the year prior to that time, the herd is currently producing up to 14 additional calves per 100 cows bred.

The practices that have contributed to the increased calving percentage in the Apache herd should be worthy of consideration by private breeders.

VI. Work Planned for the Future:

Empire and Arivaca Ranches

Emphasis during the coming year will be placed upon the analyses of postweaning data and the calculation of correlations among weaning and postweaning traits.

Apache Tribal Herd

Existing procedures will be continued during the coming year. Emphasis will be placed upon preliminary analyses of data now available. Correlations of the levels of blood and liver constituents with weights and gains will be included. It is believed that these preliminary analyses will

point out those blood and liver constituents that should receive further consideration. If certain constituents appear to be of little value, the substitution of other constituents will be considered.

VII. Publications and Manuscripts:

Pahnish, O. F., Ralph Bogart, E. B. Stanley, C. B. Roubicek, and C. E. Shelby

1958. Adjustment of weaning weights of range calves to a standard age of 270 days. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLVII.

Pahnish, O. F., C. B. Roubicek, E. B. Stanley, Ralph Bogart, and C. E. Shelby

1958. The influences of age of dam on the 270-day weaning weights of bull and heifer calves. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLVIII.

Cattle Inventory

PROJECT SUMMARY

Purebred

Arizona Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Empire	Arivaca	Apache
Bulls (12 mos. or over).	32	36	110
Cows (2 yrs. or over)	80	80	346
Heifers (yearling)	31	29	98
Bull calves ^{1/}	28	39	120
Heifer calves ^{1/}	28	23	114
Estimated cash value ^{2/}	\$60,000	\$63,000	\$230,000

^{1/} Preliminary figures, 1959.

^{2/} Cooperative projects. No accurate method of determining percentage use for breeding project.

Cow Production Data^{1/} Arizona Agricultural Experiment Station

Breed	Hereford		Hereford		Hereford	
Line	Empire		Arivaca		Apache	
Cows bred	75		66		305	
Calves born						
Alive	67		61		227	
Dead	2		2		6	
Total	69		63		233	
Calves weaned	59		61		206	
% calf crop						
Birth ^{2/}	89		92		74	
Weaning ^{3/}	79		92		68	
	Bulls		Heifers		Bulls	
	No.	Av.	No.	Av.	No.	Av.
Average:						
Birth weight	-	-	-	-	-	-
Weaning age	240		254		234	
Weaning weight	28	501	31	480	32	508
Weaning weight ^{4/}	28	555	31	504	32	566
Weaning score						
Cond. ^{5/}	28	11.5	31	11.7	32	11.6
Conf. ^{5/}	28	11.3	31	11.6	32	11.3

^{1/} 1950 calf crop.

^{2/} Calves born alive/cows bred.

^{3/} Calves weaned/cows bred.

^{4/} Weaning weights of Empire and Arivaca calves adjusted to 270 days of age, and weights of Apache calves adjusted to 205 days of age.

All weights adjusted to 7-year-old age-of-dam basis.

^{5/} Score of 11 is middle-choice feeder grade.

Land, Physical Facilities, and Equipment Used

Item	Number	Cash Value	Percentage Used for Breeding Project ^{1/}
Empire Ranch:			
Land	7 sections	\$32,330	
Fencing	18 miles	9,000	
Corrals and scales	-	4,000	
Water supply	-	3,000	
Total		48,330	
Arivaca Ranch:			
Land	7 sections	32,330	
Fencing	18 miles	9,000	
Corrals and scales	-	4,000	
Water supply	-	3,000	
Total		48,330	
Apache Reservation:			
Land	35 sections	103,000	
Fencing	50 miles	20,000	
Corrals and scales	-	4,000	
Water supply	-	12,000	
Total		139,000	
Experiment Station:			
Laboratory facilities	-	15,000	20

1/ Owned by private operators. No accurate method of determining percentage used for breeding project.

I. Station: California Agricultural Experiment Station, Davis,
California

II. Project Title: Breeding experiments to investigate the nature of
genetic improvement in beef cattle productivity with special empha-
sis on the performance of inbred lines and their crosses

III. Personnel:

Experiment Station:

W. C. Rollins, F. D. Carroll, J. W. T. Pollock, K. Sittmann,
and J. Tapia

U. S. Department of Agriculture:

R. T. Clark, Coordinator
C. E. Shelby

IV. Nature and Extent of Work Done This Year:

Testing bulls directly and by use of progeny for rate of gain, efficiency
of gain, and earliness of maturity.

This experiment is continuing according to plan. Currently, 23 bulls are
being individually fed, 6 bulls are out in cooperator herds producing
progeny test steers, and 31 steers are being fed at Davis in the progeny
testing of 4 bulls.

Data on growth during the suckling period are being gathered in the pure-
bred Hereford herd according to plan.

In the double cervix study, pedigrees have been completed on all animals
examined. Organs from 16 cows examined and believed to have double cer-
vixes were dissected to study the variability of the trait. Typical spe-
cimens were photographed. A manuscript is being prepared.

Data for a selection index based on weaning weight and weaning grade are
continuing to be gathered. In punching the data on IBM cards additional
fields have been set up for age of dam at calving and for season of birth.
A Ph.D. candidate will analyze these data during 1960-61.

Line, line-cross and top-cross comparisons of the California inbred Rover
line with various Colorado inbred lines.

Pairs of bulls chosen from those listed in Table 1, each pair consisting
of a cross-line bull and an inbred bull, are being loaned to two cooperat-
ors for top-cross tests. Growth and carcass data will be obtained from
the calves produced. Additional points of interest to compare between
progeny groups will be percentage calf crop and uniformity within progeny
groups. As indicated in last year's report, it was originally planned

to send out 4 such pairs of bulls instead of two, but an unusually high incidence of injuries and doubtful fertility (on the basis of electro-ejaculator tests) amongst both the cross-line and the inbred bulls, caused a modification of the plan.

The comparison of Rover line bulls with bulls of the Colorado Brae Arden and Royal lines in top-crosses and line-crosses at Colorado and at Mississippi continues according to plan.

The Brahman-Hereford crossbreeding experiment completed last year is being reported in three manuscripts now under preparation. These deal with cow and calf performance, the relation of live-body measurements to carcass cutout values, and carcass and meats analyses.

V. Summary of Progress:

The 1957-58 calf crop was composed of Rover line calves sired by bull 263 and Rover $\times$ Brae Arden cross-line calves sired by Brae Arden bull 4010. Postweaning growth data for these calves are presented in Table 1.

During the 1958 breeding season part of the herd was bred artificially with frozen semen from two bulls of the Brae Arden line. The remainder was bred naturally to two Rover line bulls. The reproductive results obtained are presented in Table 2.

Application of Findings

Progeny tests of 14 sires indicate that from among bulls group fed an essentially roughage ration to from 8 to 12 months of age, those bulls can be effectively selected which will sire faster gaining and more efficient steers in the feed lot. Additional data to further substantiate the above observations are being gathered. Data from 8 additional progeny groups to complete the study will be obtained by July 1961.

VI. Work Planned for the Future:

No Rover $\times$ Brae Arden cross-line bulls are now available to send out for the next breeding season in the program set up for comparing cross-line with inbred bulls on cows in cooperator herds. Next year such bulls will be available and the program will be continued as outlined in last year's report.

VII. Publications and Manuscripts:

Rollins, W. C., and K. A. Wagnon

1958. Genotype-environment interaction in a beef cattle herd. (Abs.)
Tenth International Cong. Genet. Proc. Vol. II:240.

Wagnon, K. A., and Rollins, W. C.

1959. Heritability estimates of postweaning growth to long yearling age of range beef heifers raised on grass. J. Anim. Sci. 18(3):918-924.

Table 1.--University of California yearling bulls tested for rate and efficiency of gain

Weaning to Feed Lot - 127 Days (Limited Feed--Mainly Roughage)											
Feed-lot Period - 112 Days (60% Conc., 40% Roughage)											
Bull No.	Inbreeding of Calf	240-Day Weaning Weight	240-Day WW Adj. for Age of Dam	Av. Daily Gain Weaning to Feed Lot	Wt. at End of Feed-lot Period	Age at End of Feed-lot Period	Av. Daily Gain in Feed Lot	Lbs. TDN/Cwt. Gain in Feed Lot	Slaughter Condition at end of Feed-lot Period	U.C. Grade (Av. of 5 Grades in Feed Lot)	Per-cent
Crossline											
By Brae Arden 4010											
401	0	502	507	1.51	1077	563	2.73	518	Ch.	2	87
405	0	481	480	2.01	1081	559	2.87	482	L.Ch.	2	87
415	0	580	579	2.20	1229	555	2.93	515	Ch.	2	88
416	0	455	454	1.78	1016	555	2.77	494	Gd.	3+	81
418	0	532	526	1.52	1048	553	2.59	572	Ch.	2-	84
421	0	510	515	1.71	1117	547	2.97	498	L.Ch.	2	88
426	0	509	514	1.74	1082	542	2.71	532	L.Ch.	3+	82
431	0	432	437	1.57	981	536	3.09	455	Ch.	3+	82
435	0	479	484	2.07	1110	529	3.29	434	Ch.	2	88
444	0	581	575	1.54	1140	514	3.29	447	L.Ch.	2	87
Av.	0	506	507	1.76	1088	545	2.92	495	Ch.-5 L.Ch.-4 Gd.-1	2-	85.4
Rover Line											
By Count of Yolo (U.C. #263)											
406	.11	507	498	1.58	1042	559	2.64	540	Gd.	2-	85
414	.20	488	501	1.24	995	555	2.74	495	Gd.	2-	84
419	.09	481	472	1.42	1031	553	2.96	488	Ch.	2	86
420	.12	502	493	1.17	1002	553	2.82	504	T.Gd.	2-	83
422	.07	558	557	.688	946	547	2.55	508	T.Gd.	2-	83
428	.07	629	628	1.54	1132	541	2.82	523	T.Gd.	2-	85
430	.10	583	577	1.56	1097	537	2.84	481	Ch.	2	87
433	.05	444	441	1.47	993	532	3.11	455	Ch.	2-	85
436	.10	507	520	1.35	970	528	2.82	457	T.Gd.	2	86
441	.22	560	551	1.22	994	523	2.71	529	T.Gd.	2-	84
442	.13	472	473	1.39	888	522	2.29	532	T.Gd.	2-	84
447	.12	497	506	1.69	1003	503	3.02	455	T.Gd.	2-	85
448	.10	439	444	1.35	904	495	2.86	456	Gd.	2-	84
Av.	.11	513	512	1.36	1000	534	2.78	494	Ch.-3 T.Gd.-7 Gd.-3	2-	84.7
Grand Av.		510	510	1.54	1038	539	2.84	494	Ch.-3 L.Ch.-4 T.Gd.-7 Gd.-4	2-	85.0

Table 2.--Results of University of California 1958 Breeding Season

Sires	Natural Service		Artificial Insemination			
	173	308	BA3112		BA5012	
No. of cows exposed	15	9	10		13	
No. of cows calved	14	7	3		7	
No. prob. aborted	0	0	1		0	
No. open	1	2	6		6	
Calving percentage	93	78	30		54	
No. of services (A. I.)			<u>Aborted</u>	<u>Open</u>	<u>Calving</u>	<u>Open</u> <u>Calving</u>
1			1 ¹	1 ² 11	1	1 1111
2				1 ³		1 ⁴ 11 ¹ 1
3				11	11	1 ¹ 1 ¹ 1 ¹

The BA3112 semen was about 6 months old when used.

The BA5012 semen was about 3 months old when used.

No yearling heifers were bred artificially; hence, results for yearling heifers bred naturally have not been included since they were different (poorer) than those for two-year-olds and older.

All of the cows picked for artificial insemination had good breeding histories. Since the cows bred naturally were not examined, they could not be compared so far as infections in the genital tract were concerned. After finding 2 cows with infections at inseminations, all 23 head were examined in March, 2 weeks after the start of the breeding season.

- 1 Infection March, April)
- 2 Adhesions on ovary, April)
- 3 Small cyst expressed in June) - *
- 4 Wasn't cycling--treated in April)

* See superscript in table

Cattle Inventory
Purebreds

PROJECT SUMMARY
California Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Rover	Rover × Brae Arden	Rover × Brae Arden × Rover
Station	Davis	Davis	
Bulls (12 mos. or over)	47	3	
Cows (2 yrs. or over)	44	11	
Heifers, yearlings	3	0	
Bull calves	3	4	2
Heifer calves	6	6	7
Percentage used for breeding project	100	100	100
Estimated cash value	\$48,850	\$8,150	\$1,350

Grades

Breed			
Line			
Station			
Bulls (12 mos. or over)			
Cows (2 yrs. or over)			
Steer calves			
Heifer calves			
Percentage used for breeding project			
Estimated cash value			

Young Animals on Feed
Purebreds

	Hereford	
	Number individually fed	Number group fed
Bulls	23*	
Heifers		
Steers		
Grades		
Bulls		
Heifers		
Steers		31*

* These animals are currently on feed. Those reported under "Feed-lot Performance" were involved in last year's feed trials, which were not completed at time of last year's report.

Feed-lot Performance California Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	Rover	Rover X Brae Arden	Grade - Rover
Sex	Bulls	Bulls	Steers
Number on test	13 ^{1/}	10 ^{2/}	40
Average: Age on test	422	433	Short Yearlings
Initial weight	687.9	760.6	650.6
Initial score	High standard 2	2	
Cond.	Standard 10	8	
Conf.	Low standard 1	-	Feeder
	2-(84.0%)	2-(85.2%)	
Days on test	112	112	118
Gain per head Total	311.8	327.5	296.5
Average daily gain	2.78	2.92	2.51
Efficiency of feed utilization			
Lbs. TDN/100 lbs. gain	494	495	517
or			
Lbs. gain/100 lbs. TDN	-	-	-
Final weight	999.8	1,088.1	947.1
Final score	Ch.- 3	Ch.- 5	All
Cond.	T. Gd.7	L.Ch.-4	Gd.
	Gd.-3	Gd.-1	<u>3/</u>
Conf.	2-(84.7%)	2-(85.4%)	

1/ Includes one bull handicapped by: Foot rot, nail in foot, broken horn.

2/ 11 head started; one not reported - had hardware disease, slaughtered.

3/ Carcass grades.

California Agricultural Experiment Station
Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Barns and corrals	3	\$100,000	75
Irrigated pasture	46 acres		100
Dry lots and pasture	14 acres		100

Cow Production Data

Breed	Hereford			Hereford		
Line	Rover			Rover		
Cows bred	2 yrs. & older	47		Yearlings	13	
Calves born						
Alive		40 *1			4	
Dead		3			3	
Total		43			7	
Calves weaned		37 *2			4	
% calf crop*						
Birth		81			54	
Weaning		77			31	
	Bulls	Steers	Heifers	Bulls	Steers	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Average:						
Birth weight	26 76.2		17 65.8	5 63.4		2 57.0
Weaning age	237.6		251.8	250.3		231.0
Weaning weight	25 492.2		12 467.8	3 458.0		1 387.0
Adj. weaning wt. - 180 days	402.1		378.8	360.0		322.0
Weaning score						
Cond.	- -		- -	- -		- -
Conf. Calif. scale	25 2		12 2	3 2		1 2

* Please indicate the method used in calculation.

* 1. Represents 38 cows; 2 sets of twins.

* 2. Represents 36 cows; 1 set of twin bulls carried by dam to weaning; of other set (bull and heifer), heifer calf sold at 2 months. 2 calves died of pneumonia.

$$\begin{aligned} \text{* \% calf crop: Birth} &= \frac{\text{No. of cows calving}}{\text{No. of cows exposed}} = \frac{38}{47} = 80.8 & \frac{7}{13} &= 53.8 \\ \text{Weaning} &= \frac{\text{No. of cows weaning calves}}{\text{No. of cows exposed}} = \frac{36}{47} = 76.6 & \frac{4}{13} &= 30.8 \end{aligned}$$

UNIVERSITY OF CALIFORNIA

- I. Station: California Agricultural Experiment Station, Davis, California
- II. Project Title: Genetic control of hereditary deficiencies in beef cattle with special emphasis upon dwarfism
- III. Personnel:

Experiment Station:

P. W. Gregory, F. D. Carroll, G. P. Lofgreen, L. M. Julian,
W. S. Tyler, T. J. Hage, L. M. Holm, P. C. Kennedy,
J. P. Hughes, Wilmer J. Miller, and Iola Felhaber

U. S. Department of Agriculture:

R. T. Clark, Coordinator
C. E. Shelby

IV. Nature and Extent of Work Done This Year:

The routine collection of genetic, anatomical, and other types of data for brachycephalic and dolichocephalic dwarfs, compressed types, and normal cattle has been continued. In addition to this, special progeny tests are being made of two bulls, one each from the New Mexico and Oregon stations. Different phases of the anatomy investigations have been summarized, analyzed, and published. Results from each mating test have been summarized to date.

During the past year all data of body measurements from living animals, all anatomical data, and all genetic data have been systematically assembled so that a rather complete summary, integration, analysis, and interpretation is possible.

The total number of animals with rather complete case histories autopsied to date is 673. This includes females, males, and steers of different ages, breeds, mutant types, and normal. In addition, skulls and/or metacarpals have been obtained from 179 Hereford "normal" control slaughter cows, heifers, steers, and veal calves from a local slaughterhouse. Even though "case histories" are lacking on these slaughter animals, they have proved to be valuable as a control population although it is recognized that breeding cows, bulls, and calves with complete case histories would provide more favorable control material.

V. Summary of Progress:

Genetic progress in the analysis of the dwarf complex is dependent upon detailed biological knowledge of normal animals and the various mutant

components of the dwarf complex. The objective detailed information now available is from two sources--body measurements of living animals and skeletal studies. The body measurements include weight, heart girth, height at hooks, height at withers, round measurement, head width, head length, width at hooks, relation of incisors to the anterior edge of the dental pad, and measurement of prognathia.

The progress in anatomy stems from eight specific characteristics:

1. Early fusion time of the spheno-occipital synchondrosis
2. Intermediate fusion time of the spheno-occipital synchondrosis
3. Wings of the orbito-sphenoid (W.O.S.)
4. Posterior intra-occipital synchondrosis (P.I.O.S.)

A detailed analysis of the units which compose the metacarpal, and of the three metacarpal indices:

5.
$$\frac{\text{length (epiphysis + shaft)}}{\text{smallest shaft width}} \quad \frac{(L/SW)}{SSW}$$
6.
$$\frac{\text{shaft length a (measured at point a)}}{\text{shaft width}} \quad \frac{(SLa)}{(SW)}$$
7.
$$\frac{\text{length}}{\text{shaft length a}} \quad \frac{(L)}{(SLa)}$$
8. A method for quantitating the volume of the lateral ventricles of the brain, which can be used to measure the degree of hydrocephalus

From these indices it is now evident that the syndrome of achondroplasia may have several variations in manifestation which appear to be genetically conditioned. Thus, the achondroplastic, brachycephalic, prognathic dwarf (commonly called "snorter") consistently has early fusion of the spheno-occipital synchondrosis, and the metacarpal bones are always affected. On the other hand, achondroplastic dolichocephalic dwarfs may or may not exhibit premature fusion of the spheno-occipital synchondrosis, yet the metacarpal bones are consistently affected to approximately the same manner and degree as in the achondroplastic brachycephalic, prognathic dwarfs. The genetic evidence indicates that the difference between these two achondroplastic forms is attributable to differences in modifying genes and not in the major achondroplastic conditioning gene.

Some standard ranges in value and mean norm values for each critical index, for normal and different mutant stocks of the different breeds, are now being established. These can be used in progeny testing and in various

ways in herd analysis. One study, near completion, shows the statistical differences in body weight and seven other body characteristics between heifers selected for breeding and their half sibs rejected for breeding.

Application of Findings

This study is contributing to the biological and genetic understanding of several different extremely achondroplastic types, many of which are lethal, other unthrifty, and still others more mildly achondroplastic--such as comprest and compact types. All appear to be components of the dwarf complex and genetically related. The study should aid in the development of more effective progeny testing for detecting potential dwarf carriers. The comparative study of body characteristics of cows selected for breeding and cows rejected for breeding should aid in obtaining more precise methods for selecting breeding stock. The studies of body measurements can be useful when applied to growth, size, and carcass yield.

VI. Work Planned for the Future:

The genetic studies concerning the inheritance of the various components of the dwarf complex and normal animals will be continued. As progress is made on this phase of the problem, attention will continue to be directed toward the improvement of the progeny test and the eventual development of an adequate progeny test for detecting potential dwarf producers. Concurrently with the genetic studies will be anatomical, physiological, and biological studies as in the past. New diagnostic indices will continue to be sought to aid in the separation of different components of the dwarf complex from each other and from normal.

Because of its complexity, due to differences in origin of bones preformed in cartilage as opposed to bones preformed in membrane, the skull should be one of the most favorable parts of the skeleton for developing diagnostic characteristics for detecting diversity of expression of different achondroplastic types. Achondroplasia exerts the greatest effect upon cartilage, and it follows that bones preformed in cartilage are more adversely affected than bones preformed in membrane. It is evident that in achondroplastic animals many of the multitudinous anomalies of the head are directly attributable to the failure of "cartilage" bones to fit "membrane" bones. This may also account for some of the asymmetry often found in the regions of the vault, face, and mandibles. A detailed study of the cranial and facial bones is in progress in an attempt to discover new diagnostic characteristics to aid in differentiating other components of the dwarf complex including comprest types. ^{10.}

This study employs dimensional and graphic analysis. To date, data have been collected on forty skulls. Currently, the study is directed toward "normal" and abnormal animals of a limited age range (11-13 months). This group will establish standards for further comparisons. It is because of the extensive anatomical collection that this work is possible.

Techniques for the study of the in vitro and in vivo metabolism of cartilage from achondroplastic and normal animals are being developed as part of a collateral project financed by a NIH grant. Suitable techniques developed in the NIH-financed project will be applied to achondroplastic and normal cattle.

Attention is being centered upon the relationship of the extreme hydrocephalous type to dwarfism. The bull from the New Mexico station which sired extreme hydrocephalous calves and is now being tested at the California station has produced five progeny from standard achondroplastic brachycephalic progenathic dwarf cows and twelve progeny from comprest cows most of which had previously produced dwarf calves. There are a few more comprest cows yet to calve. It is still too early to draw any conclusions. The calves will be carried to a year or more of age for observations and analysis. The bull will again be mated to the same group of comprest and dwarf cows during the 1959 breeding season. A number of extreme hydrocephalic specimens from several states are being sent to the laboratory for analysis. The time devoted to this problem will depend upon the material available for study.

Additional specimens which exhibit an "intermediate" time of closure of the S-O synchondrosis have been obtained during the past year. The number is now sufficiently large clearly to establish these as a distinct population which exhibit a modified manifestation of achondroplasia. A manuscript is in preparation.

Now that there is a considerable mass of data on body measurements for normal and several different mutant stocks, and much anatomical data from the same stocks, more attention will be devoted to the analysis of the data and the preparation of manuscripts.

There is evidence that dwarfism is a complex and is related both genetically and anatomically to comprest and compact mutants. Since both comprest and compact have been reported to be conditioned by a dominant gene, and both are related to achondroplasia either directly or indirectly, the relationship of the dwarf complex to Dexter is being tested by mating a registered Dexter bull to different components of the dwarf complex.

VII. Publications and Manuscripts:

Gregory, P. W.

1958. Integrating basic biological principles in genetic research with applications to beef cattle. W-1 Technical Committee. Handb. of 2nd W-1 Workshop. July 7-10. Tucson.

Julian, L. M., W. S. Tyler, and P. W. Gregory

1959. The current status of dwarfism. J. Amer. Vet. Med. (In press.
Accepted for publication May 13, 1959.)

Tyler, W. S., L. M. Julian, L. Z. McFarland, H. E. Evans, and
P. W. Gregory

1959. Two projections into the cranial cavity associated with achondroplastic dwarfism in beef cattle. J. Vet. Res. (In press.
Accepted for publication April 3, 1959.)

Gregory, P. W., L. M. Julian, W. S. Tyler, and T. J. Hage
Bovine achondroplasia: Dwarfs from "comprest" and normal
parents. (Manuscript).

Tyler, W. S., L. M. Julian, and P. W. Gregory
Bovine achondroplasia: Three metacarpal indices for differentiating dwarfs and normal. (Manuscript).

U.C. Dwarf Herd Inventory
May 25, 1959

	Number
1. Brachycephalic Dwarfs	
Females, breeding age	22
Females, yearlings	7
Bulls	1
2. Dolichocephalic Dwarfs	
Females, breeding age	16
Females, yearlings	1
Bulls	2
3. Comprest Type	
Females, breeding age	-
Comprest (Descendents of Colorado Domino 68th)	7
Recurrent Comprest	10
Synthetic Comprest	8
Yearlings	1
Bulls, breeding age	3
Yearlings	2
4. Heterozygous Cows	2
5. Yearlings to be Autopsied at 12 Months of Age	
Bulls	2
Heifers	1
6. Other Bulls	
Hereford	1
Compact Shorthorn	1
Dexter	1
7. 1959 Calves on Cows	
Females	23
Bulls	8

COLORADO STATE UNIVERSITY

I. Station, Colorado Agricultural Experiment Station, Fort Collins, Colorado

II. Project Title: Improvement of beef cattle through breeding. A study of inbreeding and the crossing of inbred lines within the Hereford breed

III. Personnel:

Experiment Station:

H. H. Stonaker, Kent Riddle, T. R. Blackburn, Laura Ann Harris, Beverly Bray, Dudley Campbell, A. B. Canterbury, T. M. Sutherland, Charlene Lickley, and Fanny May Swift

U. S. Department of Agriculture:

R. T. Clark, Coordinator
C. E. Shelby

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

A. New Analyses Under Way

The topic of correlated responses from gain selection is being reopened in a related project where the increase is the experimental animal. A re-evaluation of gain, efficiency, and size relationships is being made. It appears possible from present data to estimate the effect of mature size on rate of gain. Estimates of degree of automaticity in correlations between rate of gain and efficiency are being attempted. Correlations of steer gains with random "scrambled" efficiencies from the same population are considerably higher than the actual correlations found. In these data, these correlations between scrambled pairs were of the nature of $-.8$; whereas correlations found between gain and actual efficiency were $-.5$ to $-.6$. Other than automaticity a degree of correlation is forced because lower gains will be randomly paired with larger amounts of feed intake than actual and higher gains will be randomly paired with lower than actual feed intakes.

Heritability and repeatability of fertility estimates in beef cattle are under way.

B. Cumulative Production of Linecross and "Control" Cows

ESTIMATED PRODUCTION AND GROSS INCOME AS AFFECTED
BY THE BREEDING OF LINECROSS HEREFORD COW
1955-1958

Based on Cows 3 Years of Age and Over					
Line of the Dam's Sire	No. of Cows Exposed to Bulls	Percent of These Cows Raising Calves	Av. Weaning Wt. of Their Calves	Adj. Weaning Wt. of Their Calves	Pounds of Calf Per Cow Exposed
Bonanza	9	66.7	354	391	261
Brae Arden	33	93.9	441	464	436
Colorado	20	85.0	451	479	407
Don	44	90.9	431	445	404
Ft. Lewis	17	88.2	396	424	374
La Plata	27	85.2	435	456	388
Mesa	6	66.7	399	395	263
Monarch	10	90.0	367	375	336
Prospector	20	95.0	394	424	403
Royal	18	88.9	421	441	392
San Juan	33	84.8	454	472	400
Verde	7	85.7	382	406	348
Control and Other	60	68.3	404	425	290

C. 1959 GAIN AND EFFICIENCIES OF UNSELECTED INBRED AND LINECROSS
BULLS CALVED IN 1958

Sire	Inbreds			Linecrosses		
	N	Gain	Feed Req.	N	Gain	Feed Req.
Bonanza 5038	1	2.32	6.58	3	2.61	6.25
Brae Arden 6086	4	2.03	6.31	7	2.43	6.04
Colorado 6088	4	1.76	6.38	1	1.70	6.68
Monarch 5052	2	2.30	6.81	5	2.39	6.32
Prospector 4126	1	2.39	6.34	8	2.61	5.90
Real Prince 4300	1	1.66	7.39	3	2.32	6.46
Royal 6046	3	2.23	6.01	5	2.31	6.06
San Juan 4026	5	2.41	6.23	3	2.48	6.62
Tarrington 6000	3	2.75	5.86	2	1.87	6.20
SR Star Larry 2" Pure-bred Hereford "Controls"				5	2.26	6.14
Crossbreds (Hereford x Shorthorn-Angus)				3	2.81	6.42

D. Cooperative Testing

Present breeding season will mark the close of two short-term progeny testing trials with the University of California and Mississippi State University. Results of the California-Colorado tests to date have been reported in current and previous annual reports of the California station.

Progeny test matings of Fort Lewis bulls at the Coddling Ranch were continued in 1959 with 200 cows allotted to 10 bulls. Weaning data on 1959 calves will be taken this fall.

E. Weaning Data for the Hereford and Angus Groups at the Prairie, Mississippi, Station, Mississippi State University

Four Aberdeen-Angus groups at this station exceeded all Hereford groups in weight at weaning, although the Herefords exceeded the Aberdeen-Angus by 12 percent in calf crop. Weaning data for both breeds are as follows:

PERFORMANCE OF COW HERDS, PRAIRIE (MISSISSIPPI) STATION
1958 CALVES (HEREFORD)

Line	Calif. Rover 310	Natchez	Colo. Brae Arden 3112	Colo. Royal 3016 -
Location	Prairie	Prairie	Prairie	Prairie
Breed of sire	Hereford	Hereford	Hereford	Hereford
Breed of dam	Hereford	Hereford	Hereford	Hereford
Cows bred	30	30	30	30
Cows calving	27	24	27	26
Calves raised	24	23	24	22
Av. inbr. of dams (%)	-	-	-	-
Av. inbr. of calves (%)	-	-	-	-
Av. birth date	3-9-58	2-24-58	3-5-58	3-2-58
Av. birth wt. (lbs.)				
Bulls	74.0	76.0	70.0	74.0
Heifers	66.0	62.0	70.0	64.0
Calves creep fed	None	None	None	None
Av. weaning date				
Bulls				
Steers	10-16-58	10-16-58	10-16-58	10-16-58
Heifers	10-16-58	10-16-58	10-16-58	10-16-58
Av. weaning weight				
Bulls				
Steers	(15) 356.5	(7) 340.2	(13) 367.7	(11) 378.5
Heifers	(9) 357.1	(16) 343.2	(11) 379.8	(11) 361.4
Adj. av. daily gain birth to weaning*	1.43	1.41	1.53	1.52
Av. weaning type score				
Bulls				
Steers	11.0	10.4	11.0	10.9
Heifers	11.5	10.5	11.1	10.5
Av. wean. cond. score				
Bulls				
Steers				
Heifers				

() show the number of animals involved

* Weaning weight adjusted to average age of 205 days and mature dam equivalent

PERFORMANCE OF COW HERDS, PRAIRIE (MISSISSIPPI) STATION
1958 CALVES (ANGUS)

Line	Kentucky	Va. 917	Prairie Queen	Pingrey
Location	Prairie	Prairie	Prairie	Prairie
Breed of sire	Angus	Angus	Angus	Angus
Breed of dam	Angus	Angus	Angus	Angus
Cows bred	30	30	31	38
Cows calving	21	20	18	25
Calves raised	16	20	16	25
Av. inbr. of dams(%)	-	-	-	-
Av. inbr. of calves(%)	-	-	-	-
Av. birth date	3-25-58	3-19-58	3-19-58	3-19-58
Av. birth wt. (lbs.)				
Bulls	59.0	65.0	67.0	62.0
Heifers	59.0	60.0	55.0	62.0
Calves creep fed	None	None	None	None
Av. weaning date				
Bulls				
Steers	10-16-58	10-16-58	10-16-58	10-16-58
Heifers	10-16-58	10-16-58	10-16-58	10-16-58
Av. weaning weight				
Bulls				
Steers	(6) 374.9	(13) 423.2	(12) 433.2	(13) 400.0
Heifers	(9) 363.3	(7) 333.2	(4) 390.6	(12) 399.0
Adj. av. daily gain birth to weaning*	1.58	1.73	1.77	1.70
Av. weaning type score				
Bulls				
Steers	10.8	11.2	10.9	11.0
Heifers	10.0	10.8	10.2	11.4
Av. wean. cond. score				
Bulls				
Steers				
Heifers				

Average daily gain adjusted to a steer basis and mature dam equivalent.

*Indicate in notes factors adjusted for.

VI. Work Planned for the Future:

Continuation of present procedure at Fort Lewis: Analyses of cooperative tests, and continuation of appraisal of correlated results in selection, daily gain, establishment of heritability and repeatability estimates on cow fertility.

VII. Publications and Manuscripts:

Colorado Agricultural Experiment Station

1958. Beef Cattle Improvement Day and Auction. May 31. Colo. Agr. Expt. Sta. Gen. Series, Paper 683, Fort Collins.

Harris, Laura A., L. C. Faulkner, and H. H. Stonaker

1958. The effect of inbreeding on the estimated breeding soundness of yearling Hereford bulls. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLIV-1-6.

Moore, D. B.

1958. Rates of gains in Hereford bulls as affected by inbreeding, line, age, weight, years, pens, stall positions, and weaning grade. M. S. Thesis. Colorado State University, Fort Collins.

Moore, D. B., H. H. Stonaker, and Kent Riddle

1958. Rates of gain in Hereford bulls as affected by inbreeding, line, age, weight, years, and pens. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLIII-1-6.

Stonaker, H. H.

1958. What size is the right size? Amer. Heref. J. 49(5):496.

Stonaker, H. H.

1958. Breeding for beef. Colo. Agr. Expt. Sta. B. 501-S. Fort Collins.

Urick, Joseph J.

1959. Effect of age of cow, sex, and age of calf on weaning weights of Hereford range calves. M. S. Thesis. Colorado State University, Fort Collins.

Cattle Inventory

PROJECT SUMMARY

Purebred

Colorado Agricultural Experiment Station

Breed	Hereford					
Line	Verde Animas	Bonanza	Brae Arden	Colo-rado	Don	Fort Lewis
Bulls (12 mos. or over)*	1+0	1+4	4+11	1+6	1+0	-
Cows (2 yrs. or over)	13	14	27	15	21	7
Heifers, yearlings	1	6	5	1	0	0
Bull calves**	0	6	13	0	4	0
Heifer calves**	0	4	13	0	5	0
Percentage used for breeding project	100	100	100	100	100	100
Estimated cash value						

Breed	Hereford					
Line	La Plata	Mesa	Model Domino	Monarch	Pros-pector	
Bulls (12 mos. or over)*	-	-	1+1	1+7	3+9	
Cows (2 yrs. or over)	6	3	5	10	14	
Heifers, yearlings	0	0	2	5	7	
Bull calves**	0	0	4	2	5	
Heifer calves**	0	0	3	1	7	
Percentage used for breeding project	100	100	100	100	100	
Estimated cash value						

Breed	Hereford					
Line	Real Prince	Rover	Royal	San Juan		
Bulls (12 mos. or over)	1+4	2+0	3+5	1+3		
Cows (2 yrs. or over)	10	0	17	20		
Heifers, yearlings	2	0	4	4		
Bull calves	5	6	4	5		
Heifers	1	5	2	14		
Percentage used for breeding project	100	100	100	100		
Estimated cash value						

* A few of the herd bulls are on loan in Mississippi. Indicates number of herd bulls and number of yearling bulls.

** As of May 10 - calving incomplete at this time.

Cattle Inventory
Purebred

PROJECT SUMMARY
Colorado Agricultural Experiment Station

Breed	Hereford			
Line	Tarring- ton	Con- trol	Crossbred (H × A.S.) Control	On lease
Bulls (12 mos. or over)*	1+5	1+5	0+3	-
Cows (2 yrs. or over)	8	12	9	70
Heifers, yearlings	5	3	5	37
Bull calves	7	4	2	-
Heifers	10	3	4	-
Percentage used for breeding project	100	100	100	100
Estimated cash value				

Young Animals on Feed
Purebred

	Hereford		Angus		Shorthorn	
	No. Ind. Fed	No. Group Fed	No. Ind. Fed	No. Group Fed	No. Ind. Fed	No. Group Fed
Bulls	9		2		1	
Heifers						
Steers						
Grade - Crossbred (H × Angus-Shorthorn)						
Bulls	3					
Heifers						
Steers						

Cow Production Data^{1/} Colorado Agricultural Experiment Station

Breed	Hereford		Hereford		Hereford	
Line	Bonanza		Brae Arden		Colorado	
Cows bred	13		27		13	
Calves born						
Alive	7		23		12	
Dead	1		2		1	
Total	8		25		13	
Calves weaned	7		23		12	
% calf crop*						
Birth	61.5		92.6		100.0	
Weaning	53.8		35.2		92.3	
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Average:						
Birth weight	-	-	-	-	-	-
Weaning age	192	202	204	197	184	173
Weaning weight	4 334	3 397	7 441	16 362	9 401	3 398
Adj. weaning						
wt. - 200 days**	393	496	512	451	469	482

Cow Production Data^{1/}

Breed	Hereford		Hereford		Hereford	
Line	Don		Ft. Lewis		La Plata	
Cows bred	20		7		7	
Calves born						
Alive	18		7		6	
Dead	1		0		0	
Total	19		7		6	
Calves weaned	17		7		6	
% calf crop*						
Birth	95.0		100		85.7	
Weaning	85.0		100		85.7	
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Average:						
Birth weight	-	-	-	-	-	-
Weaning age	195	195	190	200	210	209
Weaning weight	5 428	12 308	2 395	5 422	3 488	3 427
Adj. weaning						
wt. - 200 days**	447	438	412	463	486	441

^{1/} 1953 calving

* Please indicate method used in calculation. Number born relative to number of cows exposed.

** Adjusted for age at weaning (200 days), age of dam, sex, and inbreeding of dam and calf.

Cow Production Data^{1/} Colorado Agricultural Experiment Station

Breed	Hereford		Hereford		Hereford	
Line	Mesa		Monarch		Prospector	
Cows bred	3		17		13	
Calves born						
Alive	3		15		13	
Dead	0		2		0	
Total	3		17		13	
Calves weaned	3		15		13	
% calf crop*						
Birth	100		100.0		100	
Weaning	100		88.2		100	
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Average:						
Birth weight	-	-	-	-	-	-
Weaning age	215	207	195	194	205	199
Weaning weight	2 425	1 375	8 394	7 369	3 433	10 405
Adj. weaning wt.- 200 days**	416	401	440	456	452	484

Cow Production Data^{1/}

Breed	Hereford		Hereford		Hereford	
Line	Real Prince		Royal		San Juan	
Cows bred	10		17		20	
Calves born						
Alive	3		14		13(1 set twins)	
Dead	2		1		3	
Total	5		15		16	
Calves weaned	3		14		13	
% calf crop*						
Birth	50.0		88.2		80.0	
Weaning	30.0		82.4		65.0	
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.	No. Av.
Average:						
Birth weight	-	-	-	-	-	-
Weaning age	212	215	195	185	192	191
Weaning weight	1 330	2 452	8 396	6 367	10 408	3 387
Adj. weaning wt.- 200 days**	462	480	470	481	464	464

^{1/} 1958 calving

* Please indicate method used in calculation. Number born relative to number of cows exposed.

** Adjusted for age at weaning (200 days), age of dam, sex, and inbreeding of dam and calf.

Cow Production Data^{1/} Colorado Agricultural Experiment Station

Breed			Hereford			
Line	Tarrington		Model Domino		Verde	
Cows bred	7		4		6	
Calves born						
Alive	5		3		6	
Dead	1		0		0	
Total	6		3		6	
Calves weaned	5		3		5	
% calf crop*						
Birth	85.7		75.0		100.0	
Weaning	71.4		75.0		83.3	
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No.	Av.	No.	Av.	No.	Av.
Average:						
Birth weight						
Weaning age	208	203	214	178	182	186
Weaning weight	3 542	2 348	1 305	2 305	4 312	1 330
Adj. weaning wt. -200 days**	561	364		332	381	391

Cow Production Data^{1/}

Breed	Hereford		Crossbred HXS-A Monarch			
Line	Control		Control			
Cows bred	13		9			
Calves born						
Alive	11		9			
Dead	2		0			
Total	13		9			
Calves weaned	10		8			
% calf crop*						
Birth	100.0		100.0			
Weaning	76.9		88.9			
	Bulls	Heifers	Bulls	Heifers	Bulls	Heifers
	No.	Av.	No.	Av.	No.	Av.
Average:						
Birth weight	-	-	-	-		
Weaning age	191	209	210	198		
Weaning weight	5 386	5 411	5 468	3 423		
Adj. weaning wt. - 200 days**	415	424	472	482		

^{1/} 1958 calving

* Please indicate method used in calculation. Number born relative to number of cows exposed.

** Adjusted for age at weaning (200 days), age of dam, sex, and inbreeding of dam and calf.

Feed-lot Performance^{1/} Colorado Agricultural Experiment Station

Breed	Hereford	Angus	Shorthorn	Crossbred
Sex	Bulls	Bulls	Bulls	Bulls
Number on test	91	2	1	3
Average:				
Initial weight	435	631	506	449
Days on test	140	140	140	140
Gain per head				
Total	30,203	742	364	1,180
Average daily gain	2.38	2.65	2.60	2.81
Efficiency of				
feed utilization				
Lbs. feed/100 lbs. gain	620	741	707	642
Final weight	763	1,002	950	842
Final grade	4.7	5.8	5.0	4.7

^{1/} See General Series Paper 709.

UNIVERSITY OF HAWAII

I. Station: Hawaii Agricultural Experiment Station, Honolulu,
Territory of Hawaii

II. Project Title: The improvement of beef cattle through the appli-
cation of breeding methods

III. Personnel:

Experiment Station:

Estel H. Cobb, and Oliver Wayman (also managers of each cooperat-
ing ranch and their stock handling personnel)

U. S. Department of Agriculture:

R. T. Clark, Coordinator

C. E. Shelby

IV. and V. Nature and Extent of Work Done This Year, and Summary of
Progress and Conclusions to Date:

Weights and conformation scores at weaning, 12 months, and 20 months of
age were obtained as planned.

All cows were weighed at weaning and scored for cancer-eye. Twenty-
seven cows, ranging in age from 4 to 15 years, had cancer-eye.

All the records from 1953-58 have been transferred to IBM cards and are
in the final stages of analysis. Estimates of the effects of age of
dam, sex, and age of calf have been obtained. The data are being
adjusted for these environmental effects and then will be analyzed with-
in ranch and year for heritabilities of weights, gains, and scores.
Phenotypic correlations between the various traits will also be obtained.

The project outline has been revised and submitted for acceptance. The
new project outline calls for the enlargement of the present program to
permit progeny testing of steer progeny from each sire and detailed car-
cass studies of these progeny. The first test progeny will be selected
at weaning in October. Facilities at the Waialeale Livestock Research
Farm on Oahu will be used for this phase of the project. In addition,
a herd of 20 registered Hereford females and 4 registered bulls will be
added to the project.

All bulls used in the project this year were semen tested. One bull out
of 12 had unsatisfactory semen.

Application of Findings

The cattlemen have shown increased interest in the project. It is felt that the information on environmental effects and heritabilities that is now being obtained will find immediate application in the field.

VI. Work Planned for the Future:

Early completion of the analysis and publication of the results of the first five years' data is planned. The progeny testing of steers from each sire will start at weaning time in October.

VII. Publications and Manuscripts:

Cobb, Estel H.

1958. The influence of heredity on beef cattle productivity. Hawaii Cattlemen's Association Twelfth Annual Meeting Proc. Nov. 1958.

Cattle Inventory

PROJECT SUMMARY

Purebred

Hawaii Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford
Line	-	-	-
Station	Kaalualu	Kapapala	Martin
Bulls (12 mos. or over)	3	3	4
Cows (2 yrs. or over)	-	-	20
Heifers, yearlings	-	-	-
Bull calves	-	-	-
Heifer calves	-	-	-
Percentage used for breeding project	100	100	100
Estimated cash value	\$2,100	\$2,900	\$20,000
Grade			
Breed	Hereford	Hereford	
Line	-	-	
Station	Kaalualu	Kapapala	
Bulls (12 mos. or over)	21	23	
Cows (2 yrs. or over)	251	100	
Bull calves	84	44	
Heifer calves	110	45	
Percentage used for breeding project	100	100	
Estimated cash value	\$95,400	\$44,125	

Young Animals on Feed None.

Hawaii Agricultural Experiment Station
Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Land (Kaalualu)	1,150 acres	\$12,600.00	100% Annual lease value
Corrals and chutes	1 set	2,400.00	100%
Portable scale	1 only	650.00	80%
Land (Kapapala)	924 acres	10,123.00	100% Annual lease value
Corrals, chute, scale	1 set	3,300.00	100%
University of Hawaii			
Portable scale	1 only	720.00	100%
Profilometer	1 set	200.00	100%
Leica camera set	1 only	613.10	50%
Electronic ejaculator	1 only	543.74	100%
Monroe adding machine	1 only	238.18	65%
Friden calculator	1 only	658.75	80%
Total value		\$32,046.77	

Cow Production Data

Breed	Hereford		Hereford	
Line	Kaalualu		Kapapala	
Cows bred	250		82	
Calves born				
Alive	205		65	
Dead	-		-	
Total	205		65	
Calves weaned	190		55	
% calf crop*				
Birth	82.0		79.3	
Weaning	76.0		67.0	
	Bulls		Heifers	
	No.	Av.	No.	Av.
Average:				
Weaning age	230.3		231.0	
Weaning weight	72 449.3	92 436.1	25 513.6	30 465.0
Adj. weaning wt. - 240 days	465.3	449.8	516.2	474.1
Weaning score				
Conf.	72 2.8	92 3.5	25 4.2	30 4.4

* Number of cows put with bull.

UNIVERSITY OF IDAHO

- I. Station: Idaho Agricultural Experiment Station, Moscow, Idaho
- II. Project Title: The improvement of beef cattle through: (1) linebreeding within the Hereford and Shorthorn breeds, (2) testing linebred sires within the various lines which will be developed, and (3) determining the relative importance of various reproductive phenomena.
- III. Personnel:
- Experiment Station:
R. E. Christian, C. W. Hodgson, T. D. Bell, and S. E. Slyter
- U. S. Department of Agriculture
R. T. Clark, Coordinator
C. E. Shelby

IV. and V. Nature and Extent of Work Done This Year and Summary of Progress and Conclusions to Date:

Performance and production data have been collected according to the project outline. Seventeen bull calves (9 Hereford, 4 Angus and 4 Shorthorn) were individually fed for 140 days to obtain feed-lot performance.

The study on age at puberty in the beef heifer was continued with the heifers from the 1958 calf crop. Heat checks were made twice daily with a vasectomized bull beginning when the heifers were approximately 8 months of age.

Table 1 gives the results of three years of work on age at puberty in the beef heifer.

Table 1	Hereford		Shorthorn		Angus	
	Number of	Age at	Number of	Age at	Number of	Age at
Year	Animals	Puberty (Days)	Animals	Puberty (Days)	Animals	Puberty (Days)
1956	16	378.1	10	383.2	9	352.8
1957	13	373.5	9	374.6	6	392.3
1958	23	348.3	9	338.0	8	369.0
Av.	52	363.8	28	365.9	23	368.7

These data would indicate that the beef heifer reaches puberty at one year of age. Also, there is relatively little variation among the three beef breeds.

All Hereford cows have been palpated per rectum following parturition to determine the length of the interval from calving to involution of the uterus and first ovulation. The results of two years' work are shown in Table 2.

Table 2

	1957	1958
Number of cows	38	35
Days to involution	41.3	42.8
Days to ovulation	44.2	43.9

Twenty-eight of the cows were included in the study both years. Neither of these reproductive phenomena are very highly repeatable as shown by the correlation between years. The correlation between days to involution in 1957 and days to involution in 1958 was $-.103$. The correlation between days to ovulation in 1957 and days to ovulation in 1958 was $.149$.

Application of Findings

Three years of work on age at puberty in the beef heifer would indicate that there is considerable yearly variation but that there is relatively little variation between breeds. The beef heifer first comes in heat at approximately one year of age. Most heifers ovulate at first heat. Some heifers do not come in heat until at least 15 months of age which may be one cause of a lower percentage calf crop from heifers bred to calve at two years of age.

The beef cow requires approximately 6 weeks for the uterus to return to normal size, tone and position following calving. The first postpartum ovulation also occurs in approximately 6 weeks.

VI. Work Planned for the Future:

The studies on reproductive phenomena in the beef cow will be continued to obtain better estimates of their influence on subsequent reproductive phenomena. Additional studies will be undertaken to determine if reliable guides can be obtained for future reproductive performance from past reproductive performance.

It is planned to begin performance testing of the heifer calves. All heifer calves will be individually fed following weaning to obtain feed-lot performance.

VII. Publications and Manuscripts:

Christian, R. E.

1958. Reproductive physiology in the cow as related to genetic improvement. Handb. of 2nd W-1 Workshop, pp. 42-48, July 7-10. Tucson.

Johnson, R. F., T. B. Keith, and W. P. Lehrer, Jr.

1958. Delayed concentrate feeding of steers. 1. As affected by time and type of roughage. Idaho Agr. Expt. Sta. B. 291.

Keith, T. B., R. F. Johnson, and W. P. Lehrer, Jr.

1958. Two ratios of concentrate to roughage, four protein levels, two corn silage levels, and two oil levels for steers. Idaho Agr. Expt. Sta. Res. B. 40.

Christian, R. E.

1959. A study of some postpartum reproductive phenomena in the cow. Idaho Acad. Sci. Proc.

Keith, T. B., W. P. Lehrer, Jr., and R. F. Johnson

1959. Formulation of Idaho steer fattening rations. Idaho Agr. Expt. Sta. B. 296.

Cattle Inventory

PROJECT SUMMARY

Purebred

Idaho Agricultural Experiment Station

Breed	Hereford	Angus	Shorthorn
Line	-	-	-
Station	Main	Main	Main
Bulls (12 mos. or over)	15	8	6
Cows (2 yrs. or over)	51	23	26
Heifers, yearlings	23	8	9
Bull calves	22	6	7
Heifer calves	21	6	11
Percentage used for breeding project	75	75	75
Estimated cash value	\$44,100	\$18,200	\$20,100
Grades			
Breed	Hereford	Angus	Shorthorn
Line	-	-	-
Station	Main	Main	Main
Bulls (12 mos. or over)	1		
Cows (2 yrs. or over)	9		
Steer calves	14	2	6
Heifer calves	6		
Percentage used for breeding project	100	100	100
Estimated cash value	\$4,500	\$400	\$1,000

Cow Production Data

Breed	Hereford				Angus				Shorthorn			
Cows bred	49				22				19			
Calves born												
Alive	45				18				18			
Dead	4				3				0			
Total	49				21				18			
Calves weaned	43				20				18			
% calf crop												
Birth	100				95.5				94.7			
Weaning	87.8				90.9				94.7			
					</							

Feed-lot Performance

Idaho Agricultural Experiment Station

Breed	Hereford	Angus	Shorthorn
Sex	Bull	Bull	Bull
Number on test	9	4	4
Average: Age on test	201.5	243.2	222.2
Initial weight Average	427	506	477
Days on test	140	140	140
Gain per head Total	283	233	300.5
Average daily gain	2.02	1.66	2.14
Efficiency of feed utilization Lbs. TDN/100 Lbs. gain	424.14	519.1	430.8
Final weight Average	710	739	778

MONTANA STATE COLLEGE

- I. Station: Montana Agricultural Experiment Station, Bozeman, Montana, and the North Montana Branch Station, Havre, Montana
- II. Project Title: Recurrent selection and record of performance selection in open and closed beef cattle herds
 - A. 1. The establishment of inbred lines of registered Hereford cattle, both horned and polled, that will result in improvement in such characters as rate and economy of gain, fertility, nursing ability, longevity, and carcass quality.
 2. The maintenance of an outbred herd of Herefords with bulls selected and furnished by the purebred breeders. The bulls are to be primarily good, high-scoring individuals according to breed association standards.
 - B. 1. The establishment of an improved herd of registered Angus cattle in which the males are selected on a high level of performance as indicated by standard record of performance procedures.
 - C. 1. The investigation of the feasibility of breeding for specific combining ability through recurrent selection.
- III. Personnel:
 - Experiment Station:
 - F. S. Willson, A. E. Flower, and E. P. Orcutt, Bozeman
 - J. J. Urick, North Montana Branch Station, Havre
 - Claude Windecker, North Montana Branch Station, Havre
 - U. S. Department of Agriculture:
 - J. R. Quesenberry, U. S. Range Livestock Experiment Station, Miles City
 - R. T. Clark, Coordinator
 - C. E. Shelby

IV. Nature and Extent of Work Done This Year:

Havre

The recurrent selection trials with the Hereford cattle are being continued. This is the seventh year for this project. During the past winter, 41 head of station steers involving 7 sire groups were fed. In addition, 7 groups of rancher steers totaling 43 head were fed as controls with the station steers. The rancher steers were obtained from ranchers within a

radius of 150 miles with reputation herds having similar environmental conditions. The calving period on these ranches extends from the latter part of March through May which is the same as that of the station. Each rancher group was gate-cut from the rest of the herd. The number of steers shown in the station sire groups represents the total population of those weaned from each breeding herd up to May 25. The size of each breeding herd in the cross-line tests was from 15 to 17 females. All the steers were lotted according to weight, the steers from rancher groups and those from station sire groups being placed in different lots, thus eliminating as much as possible any effect that might be due to lot.

As shown in Table 1, the rancher-owner of group II steers has been using Montana State College indexed bulls for the past five years, and therefore these calves are not representative of the conventional breeding methods practiced by most ranchers. They had a noticeable advantage in initial weight and daily gain over the other rancher steers.

The advantage in gain of the station steers over all rancher steers was 13.3 percent. When excluding rancher group II, the advantage was 15.0 percent. The covariance analysis method was used in testing for significance of gains between the rancher steers and the station steers. After the total gains were adjusted for initial weight differences, the test of significance of adjusted means was highly significant ($F = 30.20^{**}$).

When considering the six rancher groups (omitting group II which has been using Bozeman ROP bulls for five years) we find there is a difference in gains of 18 percent in favor of the cross-line steers. The group II steers have a 9 percent advantage in gains over each of the six rancher groups.

The regression coefficient was computed to determine the effect of initial weight on total gain. In this test $b = .202$ which was significant at the .05 level. Thus, it appears that the larger steers in this test had a slight advantage over the smaller ones in gain.

As far as weaning weights are concerned it was impossible to get a comparison of the weights of rancher steers versus station steers since the initial ages of the former were not available. However, on observing the initial weights it was noted there was as much variation between the rancher groups of steers as there was between the station steers. The initial age difference between the groups of station steers accounted for some differences, however.

Of the rancher groups, group II showed a noticeable advantage in initial weight and daily gain on test. Since the rancher-owner in this case has used ROP procedures in both female and bull selection for the past five years, it is apparent that some increased weight in calves has been obtained.

Of the station steers, the cross-lines by sires HL 1, III and HL II, 169 had noticeable advantage in both initial weight and daily gain on test over the MC controls. Two sires, HL₃ 113, and HL₃ 138, produced .1 pound advantage in gain over the MC Line 1 controls. The cross-line steers by sires HL₁ 120 and HL₂ 104 produced gains almost equal to the MC controls. These two sires, however, were below average gainers within their own sire group on test.

All the heifer replacements this year were fed out on an ad lib ration of second-cutting alfalfa.

The bull calves were individually fed for an 168-day period. After completion of the feeding period, two bulls from each of the three pure-bred lines were selected on the basis of their ROP record this summer for test herd matings. The average grain roughage ratio fed this year was approximately 1:1. The average daily gain of each of the three lines was 2.30, 2.35, and 2.45 pounds, respectively.

Table 1.--A summary of the 196-day feeding period for rancher steers vs. station steers^{1/}

Rancher Controls	No. of Head	Init. Age on Test	Init. Score	Init. Wt.	Final Wt.	Total Gain	Av. Dly. Gain
Group I	7		83	444	837	393	2.01
Group II*	6		80	470	911	441	2.25
Group III	6		82	437	836	399	2.04
Group IV	6		75	359	787	427	2.18
Group V	6		83	415	814	399	2.04
Group VI	6		80	432	848	416	2.12
Group VII	6		None	394	794	399	2.04
Av. (7 groups)			80	421	832	410	2.10
Av. (excluding Group II)			80.6	413	819	405	2.07
Station Steers							
MC Line I	8	214	81	442	838	446	2.23
Sire 641 x MC Line I							
Bred cows (Controls)							
Havre Line I Sire III x							
MC Line I cows	3	218	79	490	975	484	2.47
Havre Line I sire 120 x							
MC Line I cows	7	221	78	442	882	440	2.24
Havre Line II sire 104 x							
MC Line I cows	5	206	78	403	855	452	2.31
Havre Line II sire 169 x							
MC Line I cows	7	211	82	494	1004	510	2.60
Havre Line III sire 113 x							
MC Line I cows	5	206	79	428	895	467	2.38
Havre Line III sire 138 x							
MC Line I cows	6	200	78	415	884	469	2.39
Average		211	79.3	445	912	467	2.38

^{1/} Initial scores were according to A.H. Form 522.

* Used Montana State College bulls for past five years.

A Summary of Performance of All Heifer Calves Fed Hay ad lib
From Weaning Through the 140-Day Winter Feed Test--1958-59

Line and Sire Group	140-Day Period Test							
	No. of Head	Wean. Score	Wean. Age	Wean. Wt.	Init. Wt.	Final Wt.	Total Gain	Av. Dly. Gain
<u>Purebred</u>								
Havre Line I (Sire 983)	5	74	200	376	391	508	117	.84
Havre Line II(Sire 829)	9	80	190	398	407	528	121	.86
Havre Line III(Sire 115)	5	79	191	420	414	498	84	.60
Average		77.7	194	398	404	511	107	.76
MC Line I (Grade Controls)	9	78	197	401	404	520	116	.83
<u>Cross-line</u>								
Havre Line I (Sire 111) *	6	81	198	476	486	601	115	.82
MC Line I Cows								
Havre Line I (Sire 120) *	5	82	196	421	430	547	117	.84
MC Line I Cows								
Average		81.5	197	448	458	574	116	.83
Havre Line 2 (Sire 104) *	7	80	195	427	445	584	139	.99
MC Line I Cows								
Havre Line 2 (Sire 169) *	5	82	194	445	456	590	134	.96
MC Line I Cows								
Average		81.0	194.5	436	450	587	136	.97
Havre Line 3 (Sire 113) *	2	79	182	406	434	555	121	.86
MC Line I Cows								
Havre Line 3 (Sire 138) *	8	79	193	435	454	580	126	.90
MC Line I Cows								
Average		79	187.5	420	444	467	123	.88

The heifer data shows the performance of the cross-line matings versus the parent lines. This year the advantage of all cross-line heifers over the average of the parent lines for weaning weight, final weight off test, and daily gain on test was 9, 12, and 12 percent, respectively. Except for calves born after May 25, and for obvious culls (due to sickness or physical deformities), the numbers of heifers shown in the table on previous page represent the total population of each sire group.

Bozeman

"Warmup" gains of weanling bulls previous to feed-lot testing were again checked this year for the third consecutive year. This is the second year of the three in which the Angus calves of our herds were definitely less affected by weaning stress as indicated by difference between the breeds in immediate postweaning gains. Last year the advantage of the Angus was only slight, but in 1956 and 1958 they appeared to have considerably better records in this respect. It would seem that a study of sire effect in large populations of cattle with respect to immediate postweaning gain or loss might indicate an important genetic difference. This could be of considerable economic importance. The record of our Hereford bull calves was 16 pounds average gain for an 18-day postweaning period in 1958, whereas the Angus gained 36 pounds for the same period. Presumably, most if not all of this differential would be regained only at the usual feed conversion rates.

While the Havre report includes data on the commercial steers versus experimental steers, it should be mentioned here that the one group of commercial steers in the Havre trials which were sired on a private ranch by Bozeman ROP Hereford bulls were top for the commercial steers in those tests, and exceeded the average gains of the five other commercial groups by 9 percent at Havre.

The cross-line Hereford cows which were in their second year of production at our Red Bluff ranch, and which originated at the Havre station, produced calves which weaned in 1958 at 16 pounds average superiority over the calves from comparable age cows purchased from industry at the same time the cross-line cows were moved from Havre. These weights represent cow effect, only, this year since the same industry bulls were used on both groups to produce these calves. Last year, with bull effect different (industry bulls on purchased heifers, and bulls from Havre in three-line crosses on the line-cross heifers), the difference favored the Havre heifers' production by 33 pounds as reported last year. Calf weights were corrected to 180 days.

Test breeding of our Hereford lines is continuing at the Miles City station. The U. S. Range Station's report covers this year's results with progeny of the show type bulls, one ROP bull and one show type bull being test-bred this year.

This year a slight adjustment was made in the method of correcting for yearling weight. Computation was as follows: Linear-corrected 180-day weight (corrected also for age of dam) plus daily gain from weaning to end of test $\times$ 185 days, to bring total to a 365-day basis.

V. Summary of Progress and Conclusions to Date:

Havre

From the results of this year's feeding trial when rancher steers were fed out in the station feed lot with the station steers of the recurrent selection breeding project, the difference in gain between the two lots was found to be highly significant. The method of combining lines for specific and general combining ability appears to show some advantage in increasing weaning weight and feed-lot performance over the conventional industry breeding methods and our MC Line 1 bred cattle which have been maintained for high production.

Although a number of ranchers in this area know of the advantage of breeding cattle to produce hybrid vigor, they are still faced with the problem of obtaining ROP tested inbred bulls. Also, in some cases the ranchers are not willing to accept some of the more plain-looking inbred bulls as potentially good breeding animals since they do not have separate breeding pastures so they can actually see the results or progeny of each sire. A few progressive breeders in this area will probably influence the industry quicker than any other methods we know of to enlighten the public on the use of inbred bulls to get hybrid vigor.

Bozeman

There is no longer any question that the Extension Service program of certifying commercial calves (through the ROP association) which have been verified as having been sired by top-half bulls from official feeding tests has placed bull indexing on a sound financial footing in this State. The program is rapidly selling the idea to feeders, commercial calf producers, and purebred breeders alike.

VI. Work Planned for the Future:

Havre

This year, plans are being made to place several station inbred bulls out with commercial ranchers. It will be necessary that these ranchers maintain separate breeding herds for the station bulls so that progeny records can be obtained. This year, one sire group of steers from one of our Line 2 bulls on a commercial herd will be fed at the station along with a sample of his regular steer calves. It is hoped that in the near future cooperation such as that shown by this rancher will be forthcoming from other breeders.

Bozeman

Continued effort will be made toward securing commercial comparisons of ROP and industry programs through progeny tests of bulls. The cooperation of the U. S. Range Livestock Experiment Station in testing Bozeman bulls is appreciated and will continue to be looked for in the future. Private cooperators will be sought, and State Prison cattle may become available for test purposes.

VII. Publications and Manuscripts:

Flower, A. E.

1958. Some reproductive phenomena. Mont. State Col. Fourth Annu. Beef Prod. Sch. Proc. 4:2-4.

Orcutt, E. F.

1958. Bigger calves, better calves, more calves. Mont. State Col. Ext. C. 267.

Urick, Joseph J.

1958. Report of progress: Winter feeding projects. 1956-57. No. Mont. Br. Sta. Mont. Agr. Expt. Sta. Typed Rpt.

Urick, J. J.

1958. Some factors to consider in culling the cow herd for more production. Mont. State Col. Fourth Annu. Beef Prod. Sch. Proc. 4:60-63.

Urick, Joseph J.

1959. Report of progress. 1957-58. Anim. Indus. Dept., No. Mont. Br. Sta. Mont. Agr. Expt. Sta. Typed Rpt.

Urick, J. J.

1959. Beef cattle breeding research at North Montana Branch Station. No. Mont. Br. Sta. Field Day. June.

Willson, F. S.

1959. Bozeman station's contribution to beef cattle breeding research. No. Mont. Br. Sta. Field Day. June.

Table 1.--Bull Index (Bozeman) 1958-59 Montana Agricultural Experiment Station

-49-

	Calf Eartag (No.)	Cow Eartag (No.)	Cow Age (Yrs.)	Birth Weight (Lbs.)	Age at Weaning (Days)	180-Day Weight Corrected for Age and Age of Dam (Lbs.)	Actual Weaning Weight (Lbs.)	Daily Gain--Prewaning (Lbs.)	Warmup Gain (Lbs.)	Weight on Feed (Lbs.)	Weight off Feed (Lbs.)	Gain on Feed (Lbs.)	140-Day Average Daily Gain (Lbs.)	12-Month Corrected Weight (Lbs.)	12-Month Weight Score in 25-Pound Intervals	* Yearling Bull Grade	Gain Index	Grade Score in Intervals of 2 Points	** Yearling Index Relative 60-40 Basis	Gain from Weaning to One Year	Sire	Weighted Combined Score Rank
Hereford	H862	303	8	67	239	446	570	2.1	25	595	912	317	2.3	845	3	75	104	2	2.6	399	1	4
	H872	817	4	73	214	438	482	1.7	27	510	842	332	2.4	901	1	72	108	3	1.8	419	1	2
	H868	704	5	56	226	320	385	1.5	13	398	682	284	2.0	668	10	73	93	3	7.2	348	2	8
	H871	208	10	70	223	366	415	1.5	33	448	729	281	2.0	734	7	78	92	1	4.6	368	2	7
	H875	803	4	75	221	454	512	1.9	25	537	831	300	2.1	828	3	78	98	1	2.2	374	2	3
	H877	158	12	70	220	419	424	1.7	26	450	760	310	2.2	813	4	78	101	1	2.8	394	2	5
	H880	155	12	75	218	495	500	1.9	-10	490	810	320	2.3	863	2	78	105	1	1.6	363	2	1
	H884	152	12	84	210	498	485	1.9	-8	477	779	302	2.2	842	3	72	99	3	3.0	344	2	6
Angus	A483	40	13	70	199	472	442	1.8	28	470	800	330	2.4	892	1	80.5	109	2	1.4	420	3	1
	A462	47	6	63	246	346	450	1.5	47	497	781	284	2.0	733	7	77	94	4	5.8	387	4	7
	A467	20	7	60	236	373	470	1.7	50	520	796	276	2.0	754	6	77.5	92	3	4.8	381	4	5
	A464	14	6	65	240	335	425	1.5	30	455	766	311	2.2	735	7	78.8	103	3	5.4	400	4	6
	A463	58	4	60	243	432	432	1.9	18	550	879	329	2.4	839	3	83	109	1	2.2	407	3	4
	A468	19	8	70	235	455	573	2.4	37	610	922	312	2.2	864	2	82.8	103	1	1.6	409	3	2
	A476	43	3	35	217	343	337	1.3	55	392	618	226	1.6	672	9	69.8	75	7	7.2	329	4	8
	A480	10	3	53	210	437	455	1.9	25	480	824	344	2.5	870	1	78	114	3	1.8	433	3	3

* A.H. Form 522, U.S.D.A.

** Weighed--60% yearling weight, 40% yearling grade.

Sire Key: Hereford

1. M.S.C. Clay D Supreme 12 8991837
2. Sir Advance Domino CP 19 8952694

3. M.S.C. Batans F Restorer 2 1921764
4. Elbammar 4 of V G 1752054

Table 2.--Heifers (Bozeman) 1958-59

Montana Agricultural Experiment Station

Angus Heifers

Ear tag (No.)	Cow Ear tag (No.)	Cow Age (Yrs.)	Birth Weight (Lbs.)	Corrected Weaning Weight (Lbs.)	Actual Weaning Weight (Lbs.)	Daily Gain (Lbs.)	Warmup Gain (Lbs.)	Weight on Test (Lbs.)	Weight Off Test (Lbs.)	Gain on Feed (Lbs.)	140-Day Average (Lbs.)	12-Month Corrected Weight (Lbs.)	Age	Sire
477	(30)	8	50	303	356	1.3	21	377	606	229	1.6	599	218	4
460	(30)(50)	12	58	402	456	1.5	12	468	715	247	1.8	735	249	4
471	(3)	11	50	366	385	1.4	20	405	608	203	1.5	644	227	4
472	(154)(368)	4	52	283	335	1.2	40	375	555	180	1.3	524	221	4
482	Tat.6(26)	12	68	459	438	1.8	13	451	675	224	1.6	755	204	3
470	(92)(161)	6	55	312	397	1.4	23	420	612	192	1.4	571	231	3
461	(95)(341)	3	60	321	397	1.3	28	425	670	245	1.75	654	248	3
469	(6)	11	70	456	487	1.7	38	525	790	265	1.9	808	233	3

Hereford Heifers

876	(393)(807)	3	70	339	378	1.4	23	401	660	259	1.9	691	220	2
881	(392)(806)	3	60	352	390	1.5	20	410	612	202	1.4	611	217	2
870	(311)(701)	4	66	345	412	1.5	33	445	650	205	1.5	623	223	2
887	(320)(710)	4	67	358	405	1.6	-17	388	648	260	1.8	691	209	2
865	(160)(160)	11	60	386	410	1.5	26	436	715	279	2.0	756	221	2
866	(331)(818)	3	71	383	442	1.6	11	453	715	262	1.9	735	228	1
861	(411)(411)	7	75	342	429	1.4	16	445	665	220	1.6	638	239	1
885	(389)(808)	3	65	412	387	1.8	23	410	610	200	1.4	671	177	1
879	(339)	3	67	359	400	1.5	-17	383	572	192	1.4	618	219	1
889	(408)(408)	7	80	380	426	1.6	5	431	630	199	1.4	639	206	1
878	(195)(609)	5	75	330	386	1.4	3	389	626	237	1.7	645	220	1
850)	(371)(729)	4	75	401	510	1.8	28	538	780	242	1.7	716	240	1
450)	(306)(306)	8	67	415	524	1.9	26	550	749	199	1.4	674	236	1
863	(330)(817)	3	73	438	482	1.9	-46	436	670	234	1.7	753	214	1

1. M.S.C. Clay D Supreme 12 - 8991837

2. Sir Advance Domino CP 19 - 8952694

3. M.S.C. Bataans F Restorer 2 - 1921764

4. Elbamar 4 of VG - 1752054

Cattle Inventory Purebred

PROJECT SUMMARY Montana Agricultural Experiment Station Bozeman

Breed	Hereford	Hereford	Hereford	Linebred Hereford	Show Type Hereford	ROP Angus	Show Type Angus	Remarks
Line	H.L.1	H.L.2	H.L.3	A	B	C	D	
Station	NMBS	NMBS	NMBS	Bozeman	Bozeman	Bozeman	Bozeman	
Bulls (12 mos. or over)	9	11	10	5*	6	2	4	Values used at Bozeman: Yearlings at \$400 Herd sires at \$600
Cows (2 yrs. or over)	18	28	13	21	20	23	13	
Heifers, yearlings	7	12	6	9	5	8	4	\$250
Bull calves	7	7	3	8	6	7	3	\$200
Heifer calves	8	15	3	12	11	9	7	\$100
Percentage used for breeding project	100	100	100	60	60	60	60	\$100
Estimated cash value	\$13,105	\$18,805	\$10,530	\$12,000	\$11,300	\$10,150	\$7,450	
* Includes 3 bulls at Red Bluff Ranch.								
Grades	Have			Grades				
Breed	Hereford							
Line								
Station	NMBS							
Bulls (12 mos. or over)	1				73			\$150
Cows (2 yrs. or over)	142				34			\$75
Steer calves	47				36			\$75
Heifer calves	55				20			
Percentage used for breeding project	100							
Estimated cash value	\$50,190				\$16,200			

Young Animals on Feed Montana Agricultural Experiment Station
Purebred

Bozeman				
	Hereford		Angus	
	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	8		8	
Heifers		15		12
Steers		5		4
Purebred				
			Havre	
Bulls	14			
Heifers		25		
Steers		6		
Grade				
			Havre	
Bulls				
Heifers ^{1/}		35		
Steers ^{1/}		99		

^{1/} Includes 43 head of ranchers' steers.

Land, Physical Facilities, and Equipment Used

Bozeman

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Beef barn and corrals	1 only	\$ 20,000	60
Sheds	5 only	6,800	60
Irrigated land	200 acres	80,000	100
Saddle horses	2 only	300	60
Miscellaneous equipment		700	60
Total		\$106,000	

Red Bluff Ranch, Norris, Montana

Houses	4 only	\$ 20,000	10
Old sheds, corrals	3 only	2,000	10
New sheds	3 only	2,000	10
Deeded grazing land	9,906 at \$12.75	124,153	10
Irrigated land	273 at \$70.00	19,110	10
Saddle horses	1 only	150	10
Total		\$168,013	

North Montana Branch Station
Land, Physical Facilities and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Bull barn	1 only	\$18,000	90
Long shed	1 only	18,000	90
Home pasture	1,780 acres	35,000	100
Home farm land	200 acres	9,000	85
Leased pasture	5,000 acres	55,000	100
A.I. truck	1 only	1,500	80
Saddle horses	7 only	950	100
Scale & weigh house (home)	1 only	1,900	90
Scale & weigh house (mts.)	1 only	500	100
Corrals (home)		3,000	90
Corrals (mts.)		1,500	100
Cabins (mts.)	2 only	2,000	100
Cattle squeeze	2 only	400	100
Automatic waterers	5 only	400	90

Cow Production Data 1/ Montana Agricultural Experiment Station
Bozeman

Breed	Hereford		Hereford	
Line	R.O.P.		Show Type	
Cows bred	21		17	
Cows wintered	20		16	
Calves born	21		15	
Alive	20		14	
Dead	1		2	
Total	21		16	
Calves weaned	15		13	
% calf crop <u>2/</u>				
Birth	105		100	
Weaning	75		86.7	
	Bulls		Heifers	
	No.	Av.	No.	Av.
Average:				
Birth weight	4	70	11	72
Weaning age	4	201	11	220
Weaning weight	4	433	11	412
Adj. weaning				
wt. - 180 days	4	389	11	357
Weaning score				
Conf.	73.5		71.1	
			76.2	
				85.3

1/ 1958 calves.

2/ Of cow exposed and wintered. Cows palpated in fall. Some sold in this test.

Cow Production Data^{1/}

Montana Agricultural Experiment Station

	Bozeman				No. Mont. Br. Sta.							
Breed	Angus		Angus		Hereford							
Line	ROP		Show Type		1							
Cows bred	19		12		18							
Calves born	15		11									
Alive	14		10		14							
Dead	1		1		2							
Total	15		11		16							
Calves weaned	14		10		14							
% calf crop												
Birth ^{2/}	79		92		89							
Weaning ^{2/}	74		83		78							
	Bulls		Heifers		Bulls		Heifers		Bulls		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	6	63.2	8	52.5	6	55.8	4	63.2	7	66	9	68
Weaning age	6	201	8	225	6	220	4	229		202		193
Weaning weight	6	508	8	403	6	386	4	383	6	394	8	378
Adj. weaning												
wt. - 180 days	6	377	8	336	6	324	4	312		360		355
Weaning score												
Cond.									6	75	8	77
Conf.		81.1		71.1		75.7		82				

	North Montana Branch Station											
Breed	Hereford		Hereford		Hereford							
Line	2		3		Grade							
Cows bred	27		22		152							
Calves born												
Alive	20		14		121							
Dead	1		2		5							
Total	21		16		126							
Calves weaned	20		14		120							
% calf crop												
Birth ^{2/}	78		73		83							
Weaning ^{2/}	74		63		79							
	Bulls		Heifers		Bulls		Heifers		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	8	81	13	75	9	80	7	68	57	77	69	75
Weaning age		184		192		174		184		185		192
Weaning weight	8		12		7	390	7	379	56	421	65	399
Adj. Weaning wt.-180 days		393		373		401		372		410		379
Weaning score												
Cond.	8	72	12	78	7	75	7	76	56	76	65	80

^{1/} 1958 calves.^{2/} % calf crop calculated on basis of calves weaned
cows in herd previous fall.

Montana Agricultural Experiment Station

Feed-lot Performance (Bozeman--Bull Indexing R.O.P. 140 Days)

Breed	Hereford	Hereford	Angus	Angus
Line	R.O.P.	Show Type	R.O.P.	Show Type
Sex	Bull	Bull	Bull	Bull
Number on test	2	6	4	4
Average:				
Age on test	227	219	221	235
Initial weight	552	466	527	466
Initial score				
Conf.	81	83.8	84.6	82.3
Days on test	140	140	140	140
Gain per head				
Total	325	299	328	274
Average daily gain	2.4	2.1	2.4	2.0
Final weight	887	765	856	740
Final score				
Conf.	73.5	76.1	81	75.7

Feed-lot Performance (Bozeman--Heifers R.O.P. 140 Days)

Breed	Hereford	Hereford	Angus	Angus
Line	R.O.P.	Show Type	R.O.P.	Show Type
Sex	Heifer	Heifer	Heifer	Heifer
Number on test	9	5	4	4
Average:				
Age on test	219	218	234	229
Initial weight	448	416	455	406
Initial score				
Conf.	71.1	85.3	77.9	82
Days on test	140	140	140	140
Gain per head				
Total	220	241	231	189
Average daily gain	1.6	1.7	1.6	1.4
Final weight	669	657	686	621
Final score				
Conf.	80.4	75.5	75.0	76.4

North Montana Branch Station

Feed-lot Performance

	Control	Crossline	Crossline	Crossline
Breed	Hereford	Hereford	Hereford	Hereford
Line	MC Line 1	Havre L-1	Havre L-1	Havre L-2
Sex	Controls	× MCL-1	× MCL-1	× MCL-1
Number on test	Steer	Steer	Steer	Steer
Average:	8	3	7	5
Age on test	214	213	221	206
Initial weight	442	490	442	403
Initial score				
Cond.	81	79	73	78
Days on test	196	196	196	196
Gain per head				
Total	446	484	440	452
Average daily gain	2.28	2.47	2.24	2.31
Final weight	888	975	882	855

Feed-lot Performance

	Crossline	Crossline	Crossline	
Breed	Hereford	Hereford	Hereford	
Line	Havre L-2	Havre L-3	Havre L-3	
Sex	× L-1	× MCL-1	× MCL-1	
Number on test	Steer	Steer	Steer	
Average:	7	5	6	
Age on test	211	206	200	
Initial weight	494	428	415	
Initial score				
Cond.	82	79	73	
Days on test	196	196	196	
Gain per head				
Total	510	467	469	
Average daily gain	2.60	2.38	2.39	
Final weight	1004	895	884	

North Montana Branch Station

Feed-lot Performance

Breed	Hereford	Hereford	Hereford	Hereford
Line	Rancher	Rancher	Rancher	Rancher
Sex	Cont. Group	Cont. Group	Cont. Group	Cont. Group
Number on test	Steer	Steer	Steer	Steer
Average:	7	6	6	6
Age on test	-	-	-	-
Initial weight	444	470	437	359
Initial score				
Cond.	83	80	82	75
Days on test	196	196	196	196
Gain per head				
Total	393	441	399	427
Average daily gain	2.01	2.25	2.04	2.13
Final weight	837	911	836	787

Feed-lot Performance

Breed	Hereford	Hereford	Hereford	
Line	Rancher	Rancher	Rancher	
Sex	Cont. Group	Cont. Group	Cont. Group	
Number on test	Steer	Steer	Steer	
Average:	6	6	6	
Age on test	-	-	-	
Initial weight	415	432	394	
Initial score				
Cond.	83	80	None	
Days on test	196	196	196	
Gain per head				
Total	399	416	399	
Average daily gain	2.04	2.12	2.04	
Final weight	814	848	794	

UNIVERSITY OF NEVADA

- I. Station: Nevada Agricultural Experiment Station, Reno, Nevada
- II. Project Title: The effect of environment on selection for traits of economic importance, the relative value of several selection criteria, and reproductive studies in range beef cattle
- III. Personnel:
 - Experiment Station:
 - D. W. Cassard, J. F. Kidwell, V. R. Bohman, H. J. Weeth, W. C. Behrens, permanent and temporary farm labor, and student assistants
 - U. S. Department of Agriculture:
 - R. T. Clark, Coordinator
 - C. E. Shelby
- IV. Nature and Extent of Work Done This Year:

The maintenance of lines of cattle has continued, and data have been collected according to the project plan. For the first time this year all lines are up to planned strength in numbers so that some increase in selection in the cow herd can be anticipated. Numbers of bulls and heifers (born in 1958) tested in the 3 lines at the Reno station were 34 each, while at the Knoll Creek station in Elko County, 25 heifers and 17 bulls from the 2 lines maintained there completed winter feed-lot tests.

A major effort this year was in the direction of improved facilities for testing at both stations. At the Knoll Creek station a new testing unit providing improved individual pen facilities for all calves was completed. At Reno a more elaborate but essentially similar unit was completed and will have its first use this fall. It is expected that these improvements will result in considerably better data, especially in the measurement of feed consumption.

Since the work with laboratory animals has been set up as a separate contributing project, it is reported in a separate annual report rather than here as in the past.

V. Summary of Progress and Conclusions to Date:

Progress has been according to the project plan and it appears that the time is approaching when enough test data and selected animals have accumulated to begin evaluation of results, especially regarding the relative value of the different selection criteria in use.

Application of Findings

Since no summaries of data have as yet been made, it is premature to predict the application of any results. Progress has been reported to the industry both at meetings of the cattlemen's organization in the state and at a field day held at the Knoll Creek station annually for the past 3 years. At these times cattle have been displayed and test results enumerated and explained. This has stimulated considerable interest and more recently participation by breeders in the extension testing and cattle improvement program.

VI. Work Planned for the Future:

In addition to continuing the planned development and testing of lines, it is hoped to summarize accumulated data and make some analyses during the coming year. We are especially interested in comparing the selection differentials and progress using the 3 different selection criteria--rate of gain, economy of gain, and conformation. Estimates of environmental effects are also needed and will be obtained for the environments at the 2 stations. It is also hoped that some carcass evaluation work can be initiated in order to compare the selection criteria from this point of view.

VII. Publications and Manuscripts:

Kidwell, J. F., J. M. Harper, J. E. Hunter, P. R. Ternan, C. E. Shelby, and R. T. Clark

1959. The influence of carcass grade and fatness of yearling steers on consumer preference. (Abs.) J. Anim. Sci. 17(4):1138.

Kidwell, J. F., J. E. Hunter, P. R. Ternan, J. E. Harper, C. E. Shelby, and R. T. Clark

1959. The relation of production factors to conformation scores and body measurements, associations among production factors and the relation of carcass grade and fatness to consumer preferences in yearling steers. J. Anim. Sci. 18(3):894-903.

Ternan, P. R., J. F. Kidwell, J. E. Hunter, C. E. Shelby, and R. T. Clark

1959. Associations among conformation scores and measurements in yearling steers. J. Anim. Sci. 18(3):880-893.

UNIVERSITY OF NEVADA

- I. Station: Nevada Agricultural Experiment Station, Reno, Nevada
- II. Project Title: The effect of genetic-environmental interactions on selection responses
- III. Personnel:
- Experiment Station:
- D. W. Cassard, J. F. Kidwell, H. J. Weeth, L. Haverland, permanent and temporary farm labor, and student assistants
- U. S. Department of Agriculture:
- R. T. Clark, Coordinator
- C. E. Shelby

IV. Nature and Extent of Work Done This Year:

1. Rats: Investigations of the lines derived by selection for 70-day body weight on high and low planes of nutrition have been continued and expanded. Production of the seventh generation in each line is now underway.

An analysis was made of 28-day (weaning) and 70-day weights of the inbred and two-way-cross progeny used in establishing the base population from which the selected lines were derived. Heterosis was significant in the analysis of 70-day weights. Variation in general combining ability was highly significant in weaning weights, but not significant in 70-day weights. No reason for this is apparent. Maternal effects were highly significant at both ages.

Parents of the sixth selected generation were remated to produce second litters which were treated in the same manner as the first litters. Data on litter size and rat weight in the successive litters were analyzed for repeatability and line differences. No differences in litter size between first and second litters were apparent. Repeatability of litter size was estimated as 0.47. Line differences in weaning weights were not significant. Repeatability of weaning weight was estimated at 0.82. Differences between weaning weights of rats in first and second litters were highly significant. Differences in 70-day weight between the lines approached significance; $.10 > P(F) > .05$. The estimate of repeatability of 70-day weight was 0.11, much lower than the estimate, 0.82, for weaning weight.

Second litters of the sixth generation were sacrificed at 70 days of age, and measurements of body dimensions and organ weights were taken. These data have been analyzed and a manuscript will be submitted shortly.

2. *Tribolium*: An experiment was conducted to investigate temperature, sire, dam, and genotype-environment interaction effects on reproduction in *Tribolium*. The data consist of numbers of larvae and numbers of pupae from each of approximately 1,600 final, single pair matings (92 sires $\times$ 3 dams $\times$ 6 female progeny, 3 matings of female progeny at 33° C. and 3 matings of female progeny at room temperature). The data are complete and will be analyzed in the coming year.

3. Studies of Blood Potassium Concentration: Since analysis of whole blood from 311 sheep of 4 breeds and 2 crossbred groups revealed 2 distinct levels of potassium concentration, it was thought useful to investigate this characteristic in other animals.

A similar difference was found among 6 Hereford heifers, but no distinct groups were found among 47 Holstein cows. An analysis of whole blood from 65 rats failed to reveal any distinct groupings for blood potassium.

V. Summary of Progress and Conclusions to Date:

Sufficient progress has been made in the selection program with rats so that the evaluation of differences produced between lines can be carried on in detail. A start has been made on this work this year. The selection program continues simultaneously with this evaluation work.

Application of Findings

The results of this work with laboratory animals will be chiefly in improving the plans for breeding work with large animals. At the present time the work has not progressed far enough to have produced results that are applicable in this regard.

VI. Work Planned for the Future:

A. Proposed emphasis in expenditure of time and such funds as may be available for laboratory animal research.

Research with the lines of rats selected on high and low plans of nutrition is the most advanced of the work undertaken. Hence, it seems reasonable to give first priority to further studies of these lines.

B. Studies on physiological differences between the rat lines

A switched ration experiment is now in progress. Parents of the seventh generation are being remated to produce a second litter. First litters of each pair are assigned to a ration at random, with the restriction that half of the first litters in each line are assigned to the usual ration for the line, and the remaining half are assigned to the switched ration. Second litters from each pair are assigned to the opposite

ration. The experiment will give evidence on the effectiveness of selection on high and low planes of nutrition for performance on switched rations, and the genetic consequences of such selection. The data will be completed during the summer.

Growing rats on the roughage ration appear to be more active than those on the standard ration. An investigation of this apparent difference is being planned. If preliminary experiments indicate a sizable difference, subsequent experiments might be planned to give estimates of genetic and physiological adaptation contributions to the difference.

A digestion trial experiment is being planned. The design of the experiment will be the same as that for the switched ration experiment, and preliminary digestion trials will be executed using rats from the switched ration experiment. Data from digestion trials should help to interpret the results of selection. In particular, the digestion trial data from the treatment contrast of usual versus switched ration should be helpful.

C. Analysis of data.

An analysis of selection progress during generations 4 through 7 will be made during the coming year.

Inbreeding coefficients are being computed for the rat lines. If inbreeding coefficients of 25 to 30 percent are reasonably frequent, an analysis of the effects of inbreeding on litter size and rat weights may be made.

An analysis of the relation of coat color and weight may be made. The albino genotype appears to be more frequent in the standard select line than in the other lines.

It is hoped that all of the data from the projected experiments can be analyzed during the coming year. This is probably optimistic, but those concerned with the execution of the experiments are greatly interested in them and the data will be analyzed.

D. Change of selection plan.

Due to the importance of maternal effects, it seems reasonable that more progress might be made if the top male and female in each litter were selected than if mass selection, ignoring litters, were continued as in the past. Such a change would also help to avoid further inbreeding depression.

VIII. Publications and Manuscripts:

Kidwell, J. F., and H. J. Weeth.

1958. Sex ratio and litter size in the laboratory rat. J. Hered.

49:303-304.

Kidwell, J. F., V. R. Bohman, M. A. Wade, L. H. Haverland, and J. E. Hunter.
Evidence of genetic control of blood potassium concentration in sheep.
(Manuscript.)

Kidwell, J. F., H. J. Weeth, W. R. Harvey, L. H. Haverland, C. E. Shelby,
and R. T. Clark
Heterosis in crosses of inbred lines of rats. (Manuscript.)

Kidwell, J. F., H. J. Weeth, L. H. Haverland, C. E. Shelby, and R. T. Clark.
The effect of selection and plane of nutrition on repeatability of litter
size and weight in the laboratory rat. (Manuscript.)

NEW MEXICO STATE UNIVERSITY

I. Station: New Mexico Agricultural Experiment Station, University Park, New Mexico

II. Project Title: Breeding beef cattle for southwestern ranges

III. Personnel:

Experiment Station:

L. A. Holland, J. H. Knox, and D. W. Zinn

U. S. Department of Agriculture:

R. T. Clark, Coordinator

C. E. Shelby

IV. Nature and Extent of Work Done This Year:

Production data were gathered on both purebred and grade cattle, the latter when the herd was exposed to severe drought conditions. It is believed that the small calf crop from the grade cattle resulted from the use of large breeding pastures for single sire mating groups.

Bulls in the "out-cross" line were progeny tested for the factor causing hydrocephalic calves. Two hydrocephalic calves were born in 1958 and one in 1959.

Live measurements and carcass information were obtained on 30 steer calves representing four sire groups. These data were gathered by D. W. Zinn on calves from the grade herd which had been fattened in the college feed lots. Analysis of these data has been almost completed.

V. Summary of Progress and Conclusions to Date:

A manuscript describing the hydrocephalic lethal in the "out-cross" line has been submitted to the Journal of Heredity. Thirty-one "out-cross" line bulls have sired calves. Three have not sired abnormal calves but some of their progeny out of cows believed not to possess the factor have produced such calves. Twelve bulls have sired hydrocephalic calves. Eight bulls have been progeny tested sufficiently to indicate that they lack the factor. Eight bulls have not been mated to enough known carrier cows to give a proof.

Dr. R. L. Blackwell continued preparation of material from this station for publication. He has nearly completed a study on genetic correlations and heritabilities. He has summarized data on cow productivity relative to the cow's real producing ability and her own weaning performance. Dr. Blackwell has completed an analysis of the effects of inbreeding on weaning traits and feed-lot performance.

Application of Findings

Use of this research information should contribute to more accurate selection procedures for improving beef cattle.

VI. Work Planned for the Future:

Collection of data as described in the project outline will continue. Live measurements and carcass information will be obtained on 32 steers.

VII. Publications and Manuscripts:

Blackwell, R. L., J. H. Knox, and Paul V. Hurt

1958. Effect of age of dam on weaning weight, long yearling weight, and postweaning gains of beef cattle. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLII-1-6.

Blackwell, R. L., and J. H. Knox

1958. Scurs in a herd of Aberdeen-Angus cattle. J. Hered. 49(3):117-119.

Blackwell, R. L., J. H. Knox, and E. H. Cobb

1959. A hydrocephalic lethal in Hereford cattle. J. Hered. (In press.)

Cattle Inventory

Purebred

PROJECT SUMMARY

New Mexico Agricultural Experiment Station

Breed	Hereford	Hereford	
Line	Old	Out-cross	
Station	Main	Main	
Bulls (12 mos. or over)	9	12	
Cows (2 yrs. or over)	29	28	
Heifers, yearlings	8	3	
Bull calves	9	4	
Heifer calves	10	11	
Percentage used for breeding project	60	60	
Estimated cash value	\$16,800	\$13,450	
Grade			
Breed	Hereford	Hereford	Hereford
Line	Compact	Large	General
Station	Main	Main	Main
Bulls (12 mos. or over)	0	0	0
Cows (2 yrs. or over)	33	32	75
Steer calves	12	11	24
Heifer calves	13	13	27
Percentage used for breeding project	40	40	40
Estimated cash value	\$9,900	\$9,600	\$21,700

Young Animals on Feed

Purebred

Grade

Hereford	Hereford
Number individually fed	Number group fed
Bulls 16	0
Heifers 0	16
Steers 0	14

Hereford	Hereford
Number individually fed	Number group fed
0	0
0	0
0	32

New Mexico Agricultural Experiment Station
Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for breeding project
Range land	63,000 acres	\$189,000	33
Farm land	52 acres	52,000	33
Feed lots		30,000	50
Barns	2 only	120,000	70
Meat laboratory	1 only	100,000	10
Pathology laboratory	1 only	40,000	15
Calculators	4 only	2,800	60
Office equipment		600	60

Cow Production Data^{1/}

Breed	Hereford						Hereford					
Line	old						out-cross					
Cows bred	23						25					
Calves born												
Alive	19						21					
Dead	4						1					
Total	23 (includes 2 sets twins)						22 (Includes 1 set twins)					
Calves weaned	17						17					
% calf crop ^{2/}												
Birth	100						88					
Weaning	74						68					
	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	10	71	1	53	8	76	10	72	5	67	6	64
Weaning age		246		254		246		247		248		246
Weaning weight	7	479	2	311	8	480	6	505	6	454	5	468
Weaning weight:												
Adj. Weaning wt. - 180 days	-		-		-		-		-		-	
Weaning score												
Cond.	7	7.8	2	7.0	8	7.5	6	7.3	6	7.0	5	7.2
Conf.	7	6.4	2	5.0	8	6.4	6	7.2	6	7.3	5	6.8

^{1/} Calves born July 1, 1957--June 30, 1958 (Year-round calving)

^{2/} % birth = $\frac{\text{Number of calves born (alive and dead)}}{\text{Number of cows bred to calve in the period 7/1/57--6/30/58}} \times 100$

% weaning = $\frac{\text{Number of calves weaned}}{\text{Number of cows bred to calve in period 7/1/57--6/30/58}} \times 100$

Cow Production Data New Mexico Agricultural Experiment Station

Breed	Hereford				Hereford				Hereford			
Line	Compact				Large				General			
Cows bred	27				27				68			
Calves born												
Alive	22				20				48			
Dead	0				1				3			
Total	22				21				51			
Calves weaned	20				18				46			
% calf crop ^{1/}												
Birth	81				78				75			
Weaning	74				67				68			
	Steers		Heifers		Steers		Heifers		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight												
Weaning age		184		179		174		162		187		188
Weaning weight	4	360	16	325	9	387	9	325	26	378	18	348
Adj. weaning ^{2/}												
wt.-180 days		360		341		400		376		386		360
Weaning score												
Cond. ^{3/}												
Conf.	4	7.0	16	7.2	9	7.0	9	7.4	25	7.2	18	7.0

1/ % calf crop at birth = $\frac{\text{Number of calves born (live and dead)}}{\text{Number of cows bred to calve in 1958}} \times 100$

% calf crop at weaning = $\frac{\text{Number of calves weaned}}{\text{Number of cows bred to calve in 1958}} \times 100$

2/ Age adjustment equation was $\left(\frac{\text{actual wt.} - \text{S.B.W.}}{\text{age}} \right) 180 + \text{S.B.W.}$

S.B.W. = 70 in case of steers
= 65 in case of heifers

Weights were also adjusted for age of dam using multiplicative factors:

3 yr. old, 1.100; 4, 1.083; 5, 1.042; 6, 1.030; 7, 1.014; 8, 1.000;
9, 1.032; 10, 1.058; over 10 years old, 1.069.

3/ Based on numerical scale of one through nine, nine being most desirable conformation.

Feed-lot Performance^{1/} New Mexico Agricultural Experiment Station

Breed	Hereford	Hereford
Line	Old	Out-cross
Sex	Bulls	Bulls
Number on test	9	8
Average:		
Age on test	315	315
Initial weight	683	652
Initial score		
Cond.	-	-
Conf.	-	-
Days on test	140	138
Gain per head		
Total	322	299
Average	2.30	2.17
Efficiency of feed utilization		
# TDN/100# gain	464	493
Final weight	1,005	951
Final score		
Cond.	-	-
Conf.	-	-

^{1/} Animals completing test during calendar year 1958.

OREGON STATE COLLEGE

- I. Station: Oregon Agricultural Experiment Station, Corvallis, Oregon
- II. Project Title: Improvement of beef cattle through breeding methods, using basic physiological differences in rate and efficiency of gains

Phases of Work:

1. The development of a selection index for improving beef cattle
2. The growth pattern of calves differing in rate and efficiency of gains and according to sex, line and year
3. The relation of nitrogenous and carbohydrate constituents of blood and urine to rate and efficiency of gains
4. Further studies on heritabilities of production characteristics, physiological traits, and scores and body measurements
5. The relation of blood enzymes to rate and efficiency of gains
6. Factors that determine or influence appetite
7. Selection for greater rate and efficiency of gains on a ration composed primarily of roughage
8. The development and use of inbred lines
9. The testing of bulls of inbred lines on commercial cows to determine their value as sires of good-doing calves
10. The inheritance of tendency to chronic bloating
11. The interaction of inheritance and nutrition (or other environmental factors) in causing "crooked" calves and similar abnormalities
12. The use of physiological studies in establishing or assisting in the development of reliable indices for beef cattle improvement
13. The influence of inbreeding and other selection criteria on carcass value.
14. To determine the relationship between certain physiological factors and carcass value

III. Personnel:

Experiment Station:

Central Station, Corvallis:

Ralph Bogart, Hugo Krueger, John Kaufmes, G. I. Alexander, Robert C. deBaca, Samuel Sabin, R. W. Mason, Earl Ray, Tim Bhannasiri, Franklin Ampy, Noah England, D. C. Church, L. D. Calvin, and R. G. Peterson

Squaw Butte-Harney Livestock Station, Burns:

W. A. Sawyer, Farris Hubbert, and Joe Wallace

Eastern Oregon Branch Experiment Station, Union:

James McArthur

Malheur Branch Experiment Station, Ontario:

E. N. Hoffman

John Jacob Astor Branch Experiment Station, Astoria:

H. B. Howell

U. S. Department of Agriculture:

R. T. Clark, Coordinator

C. E. Shelby

IV. Nature and Extent of Work Done This Year:

1. The effect of inbreeding on the performance of the calves over the six-year period, 1953-58, inclusive, is being evaluated. As can be readily seen, there is a confounding between year effects and inbreeding. Preliminary analyses indicate that the inbreeding effect which can be isolated statistically is associated with a depression of birth weight, and suckling gain, and an increase in age at 500 pounds body weight. There was no effect on rate and efficiency of gains on performance test suggesting that it may have been offset by the selection of the animals for these two characteristics.

In order to develop a sound selection index one must adjust data for differences due to sex if cow productivity is to be incorporated into the index. Methods for adjusting data for differences due to sex have been examined using data from the Oregon station covering a five-year period.

Males were more variable than females in both the Angus and Hereford breeds. The method used for adjusting rates of gain of females to a male basis adjusted the variance as well as the mean.

A general formula for adjusting female rates of gain to a male basis was developed, and for the special cases where (1) the coefficients of variation are the same and, (2) the variances are the same.

In adjusting female parameters to male equivalents a sliding scale based on standard deviations among females and among males should be used, rather than applying simple additive or multiplicative corrections based on the difference between the male and female means.

2. The growth and feed efficiency pattern of the calves is being studied using data covering six years of research in which weekly weights were obtained from 500 to 800 pounds body weight and weekly feed efficiencies were obtained from 500 to 800 pounds body weight. This work is being done in cooperation with J. F. Kidwell of the Nevada station and C. E. Shelby of the Regional office. Data have been put on IBM and computations are being made. It appears that the growth curve is linear from birth to weaning and from weaning to 800 pounds body weight but the slope of the line may be different for the two periods. The slope of the growth curve is different for bulls and heifers, particularly following weaning. There are year and line effects in both rate and efficiency of gains.

3. Serum Proteins Including Albumin, α , β , and γ Globulin, Blood Urea Nitrogen, Uric Acid, and Amino Acids. Sex, breed and line differences were determined on 44 Hereford and Angus calves in these constituents at 500 and 800 pounds body weight. The levels of the various blood constituents were also related to performance.

In performance, male calves gained more rapidly than female calves. They also had lower levels of urea nitrogen than female calves at 500 pounds body weight. Within the Hereford lines, essentially the same sex differences were observed. These same sex trends were found when Hereford male and female and Angus male and female calves were compared.

Hereford males had an advantage over Angus males in feed efficiency. Rates of gain between the Hereford and Angus males were not statistically different. Hereford females were superior to Angus females on the performance test measurements of rate and efficiency of gain. In the blood serum proteins, Hereford males had a lower average percent albumin fraction and a lower albumin/globulin ratio than Angus males. No difference was found between Hereford and Angus females in serum proteins.

Line differences were practically nonexistent in the nitrogenous constituents of the blood serum when the male calves were compared except for urea nitrogen levels at 800 pounds body weight in which the Lionheart males had significantly higher levels than the Prince or David males.

Gain and feed consumption per unit of gain were highly correlated with blood urea nitrogen at 500 pounds body weight and blood uric acid at 500 and 800 pounds body weight.

4. Because of the confounding of years, lines, and sires, it has not been possible to estimate heritabilities of production traits from the Oregon data by half-sib correlations. Estimates are now being determined by offspring-dam regression analysis after adjustments for differences between years and between sexes are made.

Basic studies using mice have been conducted in which selection has been practiced on a basis of one mouse in each litter serving to represent a monoparous situation. The heritability of 45-day body weight was estimated.

Regression coefficients of 45-day body weight of offspring on 45-day weights of parents were calculated on a within line, within mating year, within sex basis. Selection had been practiced for large and small 45-day body weights of mice as monoparous animals. Methods of selecting males were (1) individual selection and (2) mother selection.

Heritability was reduced by about one-half by converting a multiparous population to a monoparous population.

Genetic interactions with such environmental factors as season of the year and diet are important factors in reducing heritability.

Heritability estimates are not independent of the breeding plan and vary with the sex of both the parents and offspring from which they are calculated.

Where both male and female mice were selected individually, the average selection differential over eight mating years was 4.36 grams (comparing the large and small selected lines). In the case where females were selected individually, but males were selected solely because of their mothers' records, the selection differential averaged 2.85 grams. Thus, in creating a selection differential, mother selection was 63 percent as effective as individual selection. In creating a response to selection, mother selection was somewhat more effective, being 75 percent of the individual selection. This is a fairly high efficiency and indicates that this type of selection could work very well in commercial herds where only a minimum amount of record-keeping is desired and where the owner wants to raise his own bulls but castrate at a young age for steer production.

5. Serum Phosphatases. The same 44 calves that were discussed in the previous two sections were also examined in relation to the serum alkaline and acid phosphatase, and serum and blood inorganic phosphate levels.

The serum alkaline phosphatase levels in Angus males were significantly higher than those in Angus females. In general, the levels for male calves were higher than the levels for female calves.

Serum acid phosphatase levels showed significant differences between sexes, all males averaging higher levels than all females. Hereford males had significantly higher levels than Hereford females.

Blood and serum inorganic phosphate levels varied from animal to animal in a manner which was unrelated to sex, significant sex differences being observed in only the Angus calves in which the males had higher levels than the females.

Rate of gain was positively related to serum alkaline phosphatase ($r = +.54$) and serum acid phosphatase ($+0.37$). Female calves showed a consistent correlation in all lines between alkaline phosphatase and rate of gain. A somewhat less consistent correlation was observed in females between acid phosphatase and rate of gain.

Encouraged by the promising results obtained in this study it was decided to make a comprehensive study of the serum phosphatases in relation to growth. Accordingly, the association of serum alkaline and acid phosphatases and serum inorganic phosphate with various performance criteria has been considered for 46 suckling calves, 52 calves on performance test and 67 adult cows.

A steady decline in serum alkaline phosphatase level with age was evident during the suckling period with a corresponding diminution in the variation in the levels. During the performance test period, the serum alkaline phosphatase level showed no decline with age but sex differences were observed at 700 and 800 pounds body weight. In the adult animals, two-year-old cows had significantly higher levels than the three-year-old cows and there was a significant over-all effect of age on serum alkaline phosphatase level.

No sex or line differences were detected in the serum acid phosphatase levels of the calves during the suckling period. During the feed performance test period an over-all sex difference was found at 700 pounds body weight. At 800 pounds body weight, the Angus males had higher levels than the Angus females. The level of the male calves increased with age while age had no effect on the level of the female calves during the feed test period. The adult cows showed no line or age differences in serum acid phosphatase.

The highest average serum inorganic phosphate level was recorded for the suckling calves at three months of age. After this peak, there was a steady decline with age in all animals. During the performance test period, significant differences were recorded between the lines but there was no influence of sex. The female calves did, however, show a significant decline in level with age. Also, in the adult cows there was a steady decline in serum inorganic phosphate level with age.

During the suckling period, there was no relationship between the blood constituents and either birth weight or suckling gain. During the feed test period, a number of correlations were found between the blood constituent and the performance data, the most consistent being that between

alkaline phosphatase level and rate of gain. At 700 and 800 pounds body weight, the relationship was found to be associated with sex differences, but at 500 pounds body weight the relationship was real and not associated with sex, age, or feed economy.

A prediction equation was developed using sex, age at commencement of the feed test period, and the serum alkaline phosphatase level at 500 pounds body weight.

6. In nonruminants, glucose levels of the blood influence appetite because appetite can be reduced by increasing the level of blood glucose. The relation of blood glucose levels to appetite in ruminants has been investigated using sheep because of lower costs of sheep experimentation compared with beef cattle.

The effects of intravenous infusion of glucose on food intake were investigated in adult ewes. Infusions of from 1.67 gram per kilogram to 8.3 gram per kilogram were given over a two-hour period and did not affect the food consumption of the ewes nor their feeding behavior. These observations cast some doubt upon the possible role of glucose as the regulating mechanism for short-term appetite control in ruminants.

7. Twenty-eight weaner heifers were individually fed from December 31, 1957, through April 18, 1958. Fourteen animals were randomly assigned to the "low-plane" ration which consisted of a full-feed of native meadow hay, 0.5 pound of barley, and 1 pound of cottonseed meal. The remaining animals received the "high-plane" ration which consisted of a full-feed of a ration made up of approximately one part native meadow hay to one part rolled barley, and one pound of cottonseed meal. All of the animals grazed together during the summer on crested wheatgrass and sagebrush-bunchgrass range.

The average performance of these animals is summarized below:

	"High-Plane"	"Low-Plane"
	(Lbs.)	(Lbs.)
Av. wt. 12/31/57	388.4	391.1
A.D.G. 12/31/57-4/18/58	1.41	0.86
Lbs. T.D.N./Lbs. gain	4.93	6.63
Lbs. T.D.N. above maintenance per lb. gain*	2.60	2.92
A.D.G. 4/18/58-7/31/58	1.54	1.70
Total gain 12/31/57-7/31/58	318.0	269.5
Correlation of winter with summer gain	-.098	-.159

* Lbs. T.D.N. for maintenance = (.0553) × (Lbs. body weight .667).

The 1957-58 test period completes seven years' work in which 196 heifers have been individually fed during the winter, and grazed together on either crested wheatgrass or native sagebrush-bunchgrass range during the summer. This phase of work has now been terminated and the data are now being summarized for publication.

The second phase of the 1958 work consisted of individually feeding 26 long-yearling heifers that were previously tested on either the high or low plane rations during the winter of 1956-57. All of these animals were full-fed a ration which consisted of approximately one part native hay to one part rolled barley plus 1.5 pounds of cottonseed meal daily.

The average performance of these animals is summarized below:

1956-57 Winter Ration	"High-Plane"	"Low-Plane"
	(Lbs.)	(Lbs.)
A.D.G. 12/31/57-3/27/58	1.83	1.84
Av. wt. 3/27/58	895.2	800.8
Lbs. T.D.N./Lbs. gain	6.36	5.75
Lbs. T.D.N. above maintenance per lb. gain	3.72	3.50
Correlation of 1956-57 winter gain with 1957-58 winter gain	.70	.06

The results of the 1957-58 work complete this phase of the study. The data collected on 49 animals over a three-year period will be summarized for publication.

8. The three lines of Hereford and one line of Angus at the Central Station have been continued by using 15-20 cows and 2 bulls in each line. The performance in the lines appears satisfactory. Good herd bull prospects in the Angus, Lionheart and Prince lines, and outstanding heifer replacements in the David line are striking. One Lionheart cow developed cancer-eye, the second animal with cancer-eye in the history of the herds at Corvallis. One bull in the Prince line is quite lame. He will be autopsied to determine the cause of the difficulty. A small herd of Beefmasters has been maintained under commercial dry-land pasture conditions in the Willamette Valley to compare their performance with that of the Hereford and Angus. Weaning weights of calves from the Beefmasters were superior to those of the Hereford and Angus raised under the same conditions.

The average 210-day weights of calves for the last calf crop by line and sex are shown below:

Line	Male	Female
	(Lbs.)	(Lbs.)
Lionheart	438	428
Prince	458	344
David	437	411
Angus	457	399

The average weight for the bulls is 448 and for the heifers 401 pounds. If these weights are adjusted for effects of inbreeding, they become 499 and 449 pounds, respectively.

It appears that a good calf crop will be dropped in each of the lines this spring. Because of the heavy demand for bulls by the Branch Stations, few are made available for other breeders. One bull was sent to the University of Wyoming and one to a breeder in Canada last year. The bulls that have been used by other breeders in the past have sired calves showing good performance.

9. Bulls from each of the three Hereford lines at Corvallis and the line at Union are being tested on commercial cows by using one bull from each of the four lines each year on commercial cows at the Union Station. The first crop of calves is now under evaluation test. Bulls by each of the four sires (about three from each) are being feed-tested. Steers by each of the four sires are being fed in lots. Gains and carcass evaluations will be obtained on the steers. Gains and feed efficiency determinations will be made on the bulls. The heifers will be kept in the herd for evaluation of their abilities in calf production. Also, bulls from the Prince and David lines are used on commercial cows at the Astoria station. Data on calves at weaning will be obtained. Some of the heifers will be kept as replacements and their abilities as calf producers will be determined.

The suckling gains of calves by two bulls used in 1957 are shown in the table below:

Suckling Gains of Calves by Sires						
Sire	Number of Calves	Gain Per Day				
		All Calves	Male	Female	Two-Year Old Dam	Older Dams
		(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
F 22	5	1.79	1.74	1.80	1.51	1.86
F 51	17	1.60	1.64	1.53	1.41	1.67

Calves are now arriving at each of these stations from the second year of this study.

10. From the results of mating bloaters, or a bloater bull to his very close relative, it appears that the tendency to chronic bloating is under strong genetic influence. It also appears that inheritance of the tendency to chronic bloating is relatively simple because of the large percentage of chronic bloating in offspring of bloater $\times$ bloater as compared to offspring in the regular breeding herds on the same feed.

11. The study of crooked calves has been very slow during the past year because the same areas which produced crooked calves in large numbers in certain herds have been relatively free of the affliction. Thus, little material has been available. The results so far indicate a genetic-nutritional interaction involved in crooked calves because it occurred only in certain areas and only certain blood lines were involved in those areas. A herd in Oregon has had several cases of convulsions in young calves. Some survive while others die. The survivors do very poorly. It appears to be under genetic control but the mode of inheritance has not been determined.

12. The following constituents were examined on 44 Hereford and Angus male and female calves at 500 and 800 pounds body weight: blood hemoglobin, hematocrit, red cell count, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, white cell count, lymphocyte count, neutrophil count, and monocyte, eosinophil and basophil counts.

The average hemoglobin level for all the male calves at 500 pounds body weight was lower than the average for the female calves. Hereford males also had lower levels than either the Hereford females or the Angus males.

Prince line male calves had lower hematocrit percentages than the Prince females at 500 pounds body weight. At 800 pounds body weight, the David males had lower levels than the David females.

The male calves had a higher average white cell count than the females at 500 pounds body weight. The Angus males also had significantly higher white cell counts than either the Angus females or the Hereford males. Within the Hereford lines, both the Lionheart and David males had higher white cell counts than the Prince males. At 800 pounds body weight, the Angus males had higher levels than the Angus females. Within the Hereford lines, the David males had higher white cell counts than the David females and the David females had higher counts than the Prince females.

Hemoglobin concentration at both 500 and 800 pounds body weight was inversely related to rate of gain and positively related to feed consumption per unit gain. At 500 pounds body weight, red cell count had an inverse relationship to rate of gain.

The hemoglobin level, red cell count, and neutrophil count at 500 pounds body weight were significantly correlated to the values for the corresponding constituent at 800 pounds body weight.

Some animals have shown temporary sterility following illness in which antibiotics were used. It seemed advisable to test the effects of antibiotics on fertility to determine if they have either harmful or beneficial effects. Normal male rabbits were used as experimental animals in order to reduce costs.

Data on semen production which included sperm motility, concentration, percent alive, percent dead, percent abnormal, and time of storage of the rabbits which were injected (intramuscularly) with therapeutic doses of terramycin, streptomycin, and penicillin for an eight-week period indicated there were neither harmful nor beneficial effects due to antibiotics when compared with the control group. The body weight and body temperature were similar to those of the controls.

13. No data were gathered during the past year on carcasses of the cattle in the breeding program. Data from the Malheur station covering two years in which choice, good, medium, common, and inferior feeder cattle were fed and complete carcass data obtained have been put on IBM for analysis.

VI. Work Planned for the Future:

1. Preliminary to the development of a sound index in which cow production traits can be incorporated, one must determine the influence of environment on traits and estimate the relationship of the traits one to the other. Data from the Squaw Butte station are being analyzed with the intent of obtaining measures of genetic, environmental and permanent environmental effects on birth weight, weaning weight, yearling weight, long-yearling weight, suckling gain, yearling gain, long-yearling gain, weaning to yearling gain, weaning to long-yearling gain, and yearling to long-yearling gain. Least-squares estimates of effects are being determined separately for heifers and steers and the data will be combined after adequate sex correction for obtaining further information. Data were complete for approximately 900 animals from 150 grandmothers and 250 dams.

Three mathematical models with various sub-models are being employed in the analyses:

- (1) to ascertain "contemporary" environmental effects the data were classified by years (1947-1956), age of dam (2-10), season of birth (days from January 1), age of dam at first calving (2, 3, or 4), and whether the cow reared a calf in the previous year
- (2) to measure "contemporary" environment and a fixed source of probable permanent environmental effect, the data were classified as above and further according to age of granddam. The least-squares estimates of age of granddam effects will indicate whether the environmental rigors endured by heifer calves, born to mothers of various ages, are reflected in their own production

- (3) after measuring the "contemporary" environmental effects and fixed permanent effects, the data are to be classified as in (2) above and using weight of dam at a base period to attempt, after removing contemporary and permanent sources of environment, to ascertain the nature of the genetic effect imparted from dam to offspring.

Sub-models will be employed in the above models to obtain repeatability estimates of the 10 dependent variables (1) among dams, and (2) among dams in granddams. The latter would exclude permanent environmental effects and 1/8 of the genetic variances and covariances. Phenotypic, environmental, and genotypic correlations will be calculated by use of the two sub-models in each of the primary models to observe the change in correlation with progressive removal of various sources of environmental and presumable genetic variance.

Collaborators in the above analyses include R. C. deBaca, W. A. Sawyer, Ralph Bogart, L. D. Calvin, R. G. Peterson, and Farris Hubbert. Because of the volume of material to be presented, it is hoped that the publications will be integrated into one or several technical bulletins in the "Rate and Efficiency ..." series being published by this station.

The study on the effects of inbreeding of the calf on suckling gains, birth weight, age at 500 pounds, feed-test gains, feed efficiency, and age at 800 pounds body weight will be completed and the material prepared for publication. The effects of inbreeding of the dam on these same characteristics of her offspring will be determined. These studies will be based on information gathered from the four inbred lines maintained at the Central Station.

2. It is planned that the study dealing with growth patterns of cattle will be completed during the next year and the material will be prepared for publication. This study entails the development of a mathematical description of normal growth and feed efficiency and the analysis of factors which contribute to variation in both growth and feed efficiency. The publication of this material will be made jointly by Kidwell, Shelby, and Bogart, representing a cooperative effort.

3. Analysis of blood serum for total protein, α , β , and γ globulin, and urea nitrogen will be run on calves at birth and each 100 lbs. increment until they reach 800 pounds body weight. The results of these analyses will be related to growth, feed efficiency, sex, and line of breeding. Cellular constituents of the blood, including red cell number, white cell differential counts, hemoglobin, and cell volume, will be determined on calves at birth and at each 100 pounds increment until they reach 800 pounds body weight. The results of these determinations will be related to growth, feed efficiency, sex, and line of breeding.

4. In cooperation with Dr. Stratton, University of Wyoming, data from the Wyoming station are being analyzed to determine genetic, phenotypic, and environmental variances and covariances for weight at end of feeding period, gain from birth to end of feeding period, gain during feeding period, and feed efficiency.

Four methods of determination will be used, based on least squares analysis computations of correction factors to allow intraclass differences to be used in an analysis of variance where mean squares are subdivided into their components of variance. Correction factors included are age of dam, year and sex, breed and line, and age at weaning. In addition, corrections for suckling gains and birth weight form the basis for comparisons utilizing both, each, and neither in computing total corrections. Heritabilities for each production trait will be determined.

5. The study of enzymatic activity as a basis for understanding why some animals are superior to others in growth performance can be made either by measuring enzymes in the blood directly or by measuring the metabolites and precursors. Since the studies on phosphatase enzymes have appeared so enlightening, it is planned to expand the studies directly to enzyme analysis to include arginase, cholinesterase, amylase, and beta-glucuronidase. The data on these enzyme concentrations in the blood will be related to production traits. Some of these studies will be conducted in cooperation with Food and Dairy Technology.

6. It appears that blood levels of glucose do not influence or control appetite. The next logical approach is to study the relation of volatile fatty acids to appetite. The plan is to determine volatile fatty acid levels in the blood of the calves on test and to relate this to daily feed intake. In addition, the level of fatty acids in the blood will be increased and decreased to determine if this will alter appetite.

7. Nineteen weaner steer and heifer calves will be individually fed a ration consisting of one part native meadow hay and one part concentrate during an 120-day winter feeding period. These animals are progeny of heifers that were tested for their ability to gain rapidly and efficiently during the winter of 1955-56. All of the heifers were bred to the same bull as two-year-olds. The data collected during 1958-59 will be used to calculate heritability estimates of rate of gain and ability to convert T.D.N. to gain under the conditions tested in this study. This work will be continued for a total of three years.

8. The three lines of Herefords and one line of Angus at Corvallis, and one line of Herefords at Union will be continued. Two bulls will be used in the four lines at Corvallis. Selection is based on an index in which suckling gains, feed-test gains, feed efficiency, and score for type and conformation are given equal weight, and is used along with minimum culling levels for fertility and freedom from defects. All cattle will be

weighed each week until a weight of 800 pounds is reached. All calves will be scored, measured, and photographed at 500 and at 300 pounds body weights. Cows will be culled primarily on the basis of the production and performance of their calves, and they will be replaced with the best young females within the line.

9. Cows at the Eastern Oregon Station, Union, will be bred to a bull of each of the three Hereford lines at Corvallis and the Hereford line at Union. In addition to age and weight of each calf at weaning, data on postweaning performance will be obtained. Three bulls by each sire will be individually fed to obtain data on rate and efficiency of gains. The steers by each sire will be fed out and rate of gain and carcass evaluations will be obtained. Heifers by each sire will be retained in the herd and their calves will be appraised at weaning to evaluate these heifers for cow productivity. Cows at the John Jacob Astor Station, Astoria, will be bred to bulls of the David and Prince lines. The calves will be appraised at weaning. Heifers that are kept for replacements will be appraised for their abilities to produce good calves.

10. One outstanding example of a chronic-bloating bull exists in the calves. He will be used on females that have bloated and on females sired by a bloater bull. The rumen contents of bloater and normal animals will be studied in artificial rumens to determine if the microflora from the two kinds of animals function differently in digestion and gas production.

11. The interaction of genetics and inheritance in causing abnormalities will be studied both in small animals (basic) and beef cattle (field studies.) Field studies will be made of areas in which crooked calves (and calves with other abnormal conditions) occur to try and find what nutritional element is involved. Careful records will be kept on all herds in these areas whether or not they are bothered with these conditions. Studies of bloodlines will be made to ascertain if possible if some are more susceptible than others to abnormalities.

12. Data are now available for determining heritability estimates of some physiological traits such as chemical constituents of the blood. Also, data are available for relating physiological phenomena to inheritance and to production traits. In particular, data on different components in the dwarf complex are available for relating cardiac function as reflected by EKG records to the inheritance of this condition. A portion of these data have been obtained from the California dwarf herd through the cooperation of Dr. P. W. Gregory. Needed data to complete the study will be gathered and the records analyzed.

13. Carcasses will be evaluated on the animals slaughtered from the breeding program. In addition, carcass data will be obtained on calves sired by bulls of the Hereford lines when these bulls are mated to commercial cows.

14. Animals on which physiological data have been collected that are slaughtered will provide an opportunity to relate the findings in the physiological studies to carcass characteristics.

VII. Publications and Manuscripts:

Alexander, G. I., Hugo Krueger, and Ralph Bogart

1958. Rate and efficiency of gains in beef cattle. V. Serum phosphatases of growing Hereford and Angus calves. Oreg. Agr. Expt. Sta. Tech. B. 42.

Alexander, G. I.

1959. The relation of the serum phosphatases to growth of genetically different groups of beef cattle. Ph.D. Thesis. Oregon State College. Corvallis.

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Alexander, G. I., and Bogart, Ralph

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Alexander, G. I., D. A. Price, Ralph Bogart, and Hugo Krueger

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1958. Effect of phosphate deficiency on feed intake and body weight of rats. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XVIII-1-4.

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Manning, R. L.

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Mason, R. W., Ralph Bogart, and Hugo Krueger

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Mason, R. W., Ralph Bogart, and Hugo Krueger

1958. Methods of adjusting data for differences due to sex. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLI-1-6.

Mason, R. W., H. H. Nicholson, Ralph Bogart, and Hugo Krueger

1959. Preponderance of hybrid losses or negative heterosis in mouse crosses. (Abs.) Biometrics 15(1):146.

Oregon Agricultural Experiment Station

1959. Research highlights at Oregon State College. The Performance Register. 1959:8-9.

Price, D. A., G. I. Alexander, Ralph Bogart, and Hugo Krueger

1959. Rate and efficiency of gains in beef cattle. VI. Breed, line, and sex differences for some blood constituents of young beef cattle. Oreg. Agr. Expt. Sta. Tech. B. 46.

Ratarasarn, Sucheep

1959. The oxygen consumption of different strains of mice. M. S. Thesis. Oregon State College. Corvallis.

Ray, Earl E.

1959. The response of different strains of mice to administered testosterone and stilbestrol. Ph.D. Thesis. Oregon State College. Corvallis.

Van Arsdell, William C. III.

1959. Cardiovascular physiology of beef cattle. I. Lead selection, cardiac axes, and the interpretation of electrocardiograms in beef cattle. Ph.D. Thesis. Oregon State College. Corvallis.

Cattle Inventory
Purebred

PROJECT SUMMARY
Oregon Agricultural Experiment Station

Breed	Hereford	Hereford	Hereford	Angus
Line	Lionheart	Prince	David	
Station	Central	Central	Central	Central
Bulls (12 mos. or over)	11	9	4	8
Cows (2 yrs. or over)	18	19	19	25
Heifers, yearlings	5	3	5	8
Bull calves	3	4	5	6
Heifer calves	10	6	6	11
Percentage used for breeding project	50	50	50	50
Estimated cash value	\$19,450	\$17,650	\$15,550	\$22,950

Young Animals on Feed
Purebred

	Hereford Number Individually Fed	Angus Number Individually Fed
Bulls	23	7
Heifers	15	8

Cow Production Data Oregon Agricultural Experiment Station

Breed	Hereford		Hereford	
Line	Lionheart		Prince	
Cows bred	17		24	
Calves born				
Alive	15		16	
Dead	0		5	
Total	15		21	
Calves weaned	15		15	
% calf crop				
Birth	88		88	
Weaning	88		63	
	Bulls		Heifers	
	No.	Av.	No.	Av.
Average:				
Birth weight	10	73.9	5	74.2
Weaning age		191.6		192.8
Weaning weight	10	392.9	5	389.6
Adj. weaning				
wt. - 180 days		372.7		369.4
Weaning score				
Cond.	10	11.3	5	11.5
Conf.	10	11.9	5	11.9

Cow Production Data

Oregon Agricultural Experiment Station

Breed	Hereford		Angus	
Line	David		-	
Cows bred	15		21	
Calves born				
Alive	8		17	
Dead	0		1	
Total	8		18	
Calves weaned	8		15	
% calf crop				
Birth	53		86	
Weaning	53		71	

Feed-lot Performance

Oregon Agricultural Experiment Station

Breed	Hereford		Hereford		Hereford		Angus	
Line	Lionheart		Prince		David		-	
Sex	M	F	M	F	M	F	M	F
Number on test	10	5	10	5	3	5	7	8
Average:								
Age on test	236.87		257.34		248.25		239.07	
Initial weight	500		500		500		500	
Initial score								
Cond.	11.38		10.87		11.03		11.20	
Conf.	11.97		11.24		11.38		11.95	
Days on test	127.2		119.6		140.6		140.7	
Gain per head								
Total	300		300		300		300	
Average daily gain	2.36		2.51		2.13		2.13	
Efficiency of								
feed utilization								
Lbs. feed/100 lbs. gain	358.22		818.50		901.44		958.83	
Final weight	800		800		800		800	
Final score								
Cond.	12.70		12.32		12.07		12.22	
Conf.	13.00		12.75		12.13		12.83	

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Irrigated pastures	70 acres	\$28,000	50
Dry land pastures	89 acres	29,250	50
Barns and lots	-	70,000	50
Squeeze chutes	2 only	750	50
Feed carts	1 only	100	50

U. S. RANGE LIVESTOCK EXPERIMENT STATION

I. Station: U. S. Range Livestock Experiment Station, Miles City, Montana

II. Project Titles:

APH dl-1 Rev. The development and testing of methods of measuring performance in beef cattle

APH dl-2 Rev. Development of superior lines of beef cattle

III. Personnel:

U. S. Range Livestock Experiment Station, Miles City, Montana
J. R. Quesenberry, R. R. Woodward, and F. J. Rice

Office of Coordinator, Denver, Colorado
R. T. Clark, Coordinator, and C. E. Shelby

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Project APH dl-1 Rev. The development and testing of methods of measuring performance in beef cattle

Carcass improvement continues to be the major objective in this project. Data collected at slaughter again included rib samples for physical separation and tenderness evaluation at the Meats Laboratory at Beltsville. Body form measurements, rib eye tracings, and color and yield determination were made.

A relationship study covering the 1954-57 production and slaughter data has been completed and is now in press. Production and body form records of 210 head of Record of Performance steers, and physical separation and tenderness data from 56 steers, were included.

A brief summary follows:

None of the growth records was closely related to any of the measures of carcass quality studied, including tenderness.

Growth was related to amount of lean more than to amount of fat as measured by the physical separation data.

Neither slaughter nor carcass grade was closely related to tenderness.

Both grades were associated with width measurements and fat more than with length measurements and lean.

Specific measures of length were related to other measures of length more than to width, and vice versa.

Dressing yield was not closely associated with any particular measure of body form.

Most records of performance as presently applied should have little effect upon carcass quality.

Heritabilities of various traits were estimated from records of 542 Hereford bulls fed in record-of-performance tests from 1940 to 1954. The bulls were by 116 sires from 11 inbred lines. The following heritabilities were obtained: birth weight 59, gain from birth to weaning (180 days) 40, weaning weight (180 days) 43, weaning score 60, feed-lot gain (196 days) 46, final weight 77, and efficiency of feed utilization 32. Estimates were obtained by paternal half-sib correlations. Total variance was greater for most traits than in the steers. Differences between years was the most important source of variance. Weaning weight, gain in the feed lot, efficiency of feed utilization, and final weight, varied importantly between lines. Weight at 13 months appeared to be the most valuable criterion for selection.

Project APH d1-2 Rev. Development of superior lines of beef cattle

Several more top-cross tests, to be supervised by extension personnel, have been initiated. Comparable preweaning data from Miles City bulls and bulls from other sources will be collected in herds in four Western States this year.

An agreement was initiated with Eastern Iowa Breeders to collect semen from Miles City bulls for a test in the Iowa State herd. Comparative top-cross data will be collected.

Existing inbred Hereford lines were maintained throughout the year with no additional purchases or sales. All lines are being bred as minimum two-sire lines, as breeding facilities and numbers permit.

The top-cross test of bulls from the Montana station has almost reached the completion of the feed-lot phase. This test compares the ability of bulls selected by visual appraisal by the Montana Hereford Association with line-bred bulls from the Montana and Miles City herds. Growth records to date are as follows (efficiencies not computed until completion of test):

	T1	T2	T5	T6	T7
Sire	Line 4	Line 1	Montana	Montana	Line 6
	Miles City	Miles City	Sire 1	Sire 2	
Birth weight (lbs.)	35.9	90.0	78.0	80.4	81.9
180-day weaning wt. (lbs.)	400.8	428.3	387.4	390.0	403.5
Av. daily gain (lbs.)	2.19	2.65	2.37	2.15	2.32

The gain records of the Miles City Line 4 bull (2.12) and Line 6 bull (2.26) were both below the within-year average (2.34) of all bulls tested. The gain record of the Miles City Line 1 bull (2.49) was above the within-year average of all bulls tested. Similarly, the Montana 1 bull was above the within-year mean and the Montana 2 bull below. (Exact records of Montana bulls are not available.)

The first group of steers from the Charollais herd is now being tested in the feed lot. These steers are presumed to be approximately 15/16th Charollais, 1/16 Hereford. In the same test are 2 sire groups of Charollais × Hereford steers. Their growth records to date are as follows:

Herd	Charollais	Charollais × Hereford	Charollais × Hereford	Line 1 Hereford
Birth wt. (lbs.)	81.1	93.4	89.0	90.0
180-day weaning wt. (lbs.)	451.4	476.0	454.9	428.3
Av. daily gain (lbs.)	2.42	2.81	2.49	2.65

Both Charollais × Hereford groups are from grade Hereford cows assorted in the same way as the other herds used in the line top-cross tests. Observations on the small sample of Charollais now available indicate great variability in a number of traits. Individual variation is high for growth rate, temperament, and conformation. The offspring of one Charollais herd sire appear very promising. The others are intermediate in comparison with the Herefords.

Calves from matings of Brown Swiss bulls on Hereford cows are being born this year. Birth weights are heavier than the average of the Hereford calves. Similarly, birth weights of calves from the Brown Swiss control herd cows are heavier than the Herefords.

VI. Work Planned for the Future:

Carcass evaluation work will be continued and strengthened, if funds are available. When sufficient data have been accumulated in the laboratory analyses, it is hoped that heritabilities can be established for the more important characteristics.

Because of the expense and difficulty in obtaining desirable animals, the Charollais cattle will be increased by back-crosses of the hybrids to Charollais bulls. It is hoped that the Brown Swiss control herd can be increased by purchase.

Data analyses planned include a selection study of Line 1 and possibly other lines. Line 1 has now been in existence 25 years.

VII. Publications and Manuscripts:

Woodward, R. R., and F. J. Rice

1958. Variation in weight-constant body length measurements of Hereford bulls. (Abs.) J. Anim. Sci. 17(4):1146-1147.

Woodward, R. R.

1958. Optimum marketing dates for range cattle as determined by seasonal gains. Mont. State Col. Fourth Annu. Beef Prod. Sch. Proc. 4:21-26.

Woodward, R. R., F. J. Rice, J. R. Quesenberry, R. L. Miner, R. T. Clark, and F. S. Willson

1959. Relationships between measures of performance, body form, and carcass quality of beef cattle. Submitted as Mont. Agr. Expt. Sta. B.

Woodward, R. R.

1959. We need to remodel our livestock. Farm Profit. July-August:2-3.

Cattle Inventory
Purebreds

PROJECT SUMMARY
U. S. Range Livestock Experiment Station

Breed	Hereford	H	H	H	H	H
Line	1	4	5	6	9	10
Station	U. S. Range Station					
Bulls (12 mos. or over)	11	3	3	5	4	3
Cows (2 yrs. or over)	180	40	26	36	50	41
Heifers, yearlings	62	13	10	15	17	16
Bull calves*	55	8	8	16	14	15
Heifer calves*	53	10	8	8	10	8
Percentage used for breeding project	100					
Estimated cash value	\$282,700 (Total)					
Grades						
Breed	Hereford					
Line	Unregistered					
Station	U. S. Range Station					
Bulls (12 mos. or over)	0					
Cows (2 yrs. or over)	343					
Bull calves*	98					
Heifer calves	80					
Percentage used for breeding project	80					
Estimated cash value	\$85,900 (Total)					

* Includes 1959 calves born through April 30, 1959.

Cattle Inventory

PROJECT SUMMARY

Purebreds

U. S. Range Livestock Experiment Station

Breed	H	H	H	Char.	Br. Sw.
Line	11	12	14		
Station	U. S. Range Station				
Bulls (12 mos. or over)	0	3	3	3	1
Cows (2 yrs. or over)	31	34	45	19	15
Heifers, yearlings	16	15	0	7	0
Bull calves*	10	8	12	7	2
Heifer calves*	10	13	8	6	6
Percentage used for breeding project					
Estimated cash value					
Grades					
Breed					
Line					
Station					
Bulls (12 mos. or over)					
Cows (2 yrs. or over)					
Bull calves*					
Heifer calves					
Percentage used for breeding project					
Estimated cash value					

* Includes 1959 calves born through April 30, 1959.

Young Animals on Feed U. S. Range Livestock Experiment Station
Purebreds

	Hereford		Charollais		Crossbred H x C	
	No. ind. fed	No. group fed	No. ind. fed	No. group fed	No. ind. fed	No. group fed
Bulls	77		3		1	
Heifers						
Steers				7		
Grades						
Bulls						
Heifers						
Steers		36				14

Cow Production Data U. S. Range Livestock Experiment Station

Breed	Hereford						Hereford					
Line	L1						L4					
Cows bred	196*						32*					
Calves born												
Alive	140						27					
Dead	9						0					
Total	149						27					
Calves weaned	139						27					
% calf crop												
Birth	79.1						87.1					
Weaning	72.8						87.1					
* 5 cows sold after breeding season. Percentage calf crop figured on 191 cows remaining.						* 1 cow sold after breeding season. Percentage calf crop figured on 31 cows remaining.						
	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	47	80.1	35	82.7	68	75.4	7	82.4	7	77.3	13	78.2
Weaning age	189.8		182.1		188.3		193.3		171.7		182.2	
Weaning weight	41	454.6	35	404.2	63	415.3	7	431.1	7	365.9	13	380.3
Adj. weaning wt. - 180 days	434.8		400.7		400.3		407.7		381.1		375.9	
Weaning score												
Cond.-Conf.	41	7.9	35	7.4	63	7.7	7	7.7	7	7.4	13	7.3

Cow Production Data U. S. Range Livestock Experiment Station

Breed	Hereford			Hereford								
Line	L5			L6								
Cows bred	24			39*								
Calves born												
Alive	18			33								
Dead	1			0								
Total	19			33								
Calves weaned	18			33								
% calf crop												
Birth	79.2			86.8								
Weaning	75.0			86.8								
				* 1 cow sold after breeding season. Percentage calf crop figured on 38 cows remaining.								
	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	7	74.4	1	80.0	11	74.5	6	67.2	10	66.2	17	62.8
Weaning age		197.7		193.0		187.0		191.0		184.5		197.7
Weaning weight	6	420.8	1	381.0	11	389.1	6	421.0	10	373.1	17	395.2
Adj. Weaning wt. - 180 days		390.3		361.0		377.4		401.2		365.6		365.8
Weaning score												
Cond.-Conf.	6	8.2	1	7.7	11	7.8	6	8.0	10	7.2	17	7.8

Cow Production Data U. S. Range Livestock Experiment Station

Breed	Hereford-Polled			Hereford								
Line	L9			L10								
Cows bred	50*			40*								
Calves born												
Alive	39			31								
Dead	2			2								
Total	41			33								
Calves weaned	36			30								
% calf crop												
Birth	83.7			84.6								
Weaning	73.5			76.9								
	* 1 cow sold after breeding season. Percentage calf crop figured on 49 cows remaining.			* 1 cow died after breeding season. Percentage calf crop figured on 39 cows remaining.								
	Bulls		Steers	Heifers	Bulls		Steers	Heifers				
	No.	Av.	No.	Av.	No.	Av.	No.	Av.				
Average:												
Birth weight	5	76.8	14	74.6	22	66.2	10	81.2	6	79.7	17	74.7
Weaning age		199.3		191.8		191.8		191.4		187.7		180.1
Weaning weight	4	469.5	14	411.2	18	392.1	8	433.4	6	394.3	16	372.3
Adj. weaning wt. - 180 days		431.5		390.6		371.7		413.5		382.0		371.4
Weaning score												
Cond.-Conf.	4	7.8	14	7.4	18	7.7	8	7.8	6	7.1	16	7.4

Cow Production Data U. S. Range Livestock Experiment Station

Breed	Hereford						Hereford					
Line	L11						L12					
Cows bred	29						28					
Calves born												
Alive	24						25					
Dead	1						2					
Total	25						27					
Calves weaned	24						25					
% calf crop												
Birth	86.2						96.4					
Weaning	82.8						89.3					

Cow Production Data

U. S. Range Livestock Experiment Station

Breed	Hereford						Charollais					
Line	D						Charollais					
Cows bred	28						19					
Calves born												
Alive	24						18					
Dead	2						0					
Total	26						18					
Calves weaned	23						18					
% calf crop												
Birth	92.9						94.7					
Weaning	82.1						94.7					
	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	1	81.0	9	69.8	16	68.1	3	84.0	8	81.6	7	71.0
Weaning age		0		183.4		183.9		175.0		170.0		187.4
Weaning weight	0	000.0	9	379.3	14	349.3	3	469.7	8	430.5	7	427.1
Adj. weaning wt. - 120 days		00.0		362.4		335.9		421.0		450.6		414.0
Weaning score												
Cond.-Conf.	0	0.0	9	6.9	14	6.6	3	8.4	8	7.7	7	7.9

Cow Production Data

U. S. Range Livestock Experiment Station

Breed	Hereford X Charollais						Hereford					
Line	Crossbreds						Grades-Unregistered					
Cows bred	62*						155					
Calves born												
Alive	44						120					
Dead	2						0					
Total	46						120					
Calves weaned	43						119					
% calf crop												
Birth	83.6						77.4					
Weaning	78.2						76.8					
* 6 cows sold, 1 died after breeding season. Percentage calf crop figured on 55 cows remaining.												
	Bulls		Steers		Heifers		Bulls		Steers		Heifers	
	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.	No.	Av.
Average:												
Birth weight	3	99.3	21	92.4	22	82.3	0	00.0	60	81.0	60	74.2
Weaning age		208.0		173.2		179.9		000.0		185.5		184.9
Weaning weight	1	536.0	21	450.9	21	413.7	0	000.0	60	405.4	59	385.2
Adj. weaning wt. - 180 days		480.0		463.5		413.6		000.0		395.9		376.0
Weaning score												
Cond.-Conf.	1	8.2	21	8.4	21	7.9	0	0.0	60	7.7	59	7.6

Feed-lot Performance

U. S. Range Livestock Experiment Station

Breed	Hereford	Hereford	Hereford	Hereford	Hereford
Line	1	4	5	6	9
Sex	Male	Male	Male	Male	Male
Number on test	38	7	6	6	3
Average:					
Age on test	192.0	193.3	197.7	191.0	197.7
Initial weight	454.4	418.6	415.2	414.3	463.3
Initial score					
Cond.-Conf.	7.9	7.7	8.2	8.0	7.8
Days on test	196	196	196	196	196
Gain per head					
Total	439.1	459.7	362.0	407.8	401.3
Average	2.24	2.35	1.85	2.08	2.05
Efficiency of feed utilization					
# Gain/100# TDN	21.30	22.95	20.34	21.23	20.81
Average:					
Final weight	893.5	878.3	777.2	822.2	864.7
Final score					
Cond.-Conf.	-	-	-	-	-

Feed-lot Performance U. S. Range Livestock Experiment Station

Breed	Hereford	Hereford	Hereford	Charollais	Hereford X Charollais
Line	10	11	12	C	Crossbred
Sex	Male	Male	Male	Male	Male
Number on test	8	5	4	3	1
Average: Age on test	191.4	193.2	181.5	175.0	208.0
Initial weight	426.6	463.0	461.3	462.7	553.0
Initial score Cond.-Conf.	7.8	8.4	8.1	8.4	8.2
Days on test	196	196	196	196	196
Gain per head Total	413.1	468.2	512.8	432.0	464.0
Average	2.11	2.39	2.62	2.20	2.37
Efficiency of feed utilization # Gain/100# TDN	20.57	20.42	22.98	21.47	20.13
Average: Final weight	839.0	931.2	974.0	894.7	1,017.0
Final score Cond.-Conf.	-	-	-	-	-

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Land	56,000 A.	812,500.00	92
Buildings, corrals, land im- provements, fence and resi- dences, etc.		\$2,500,000.00	92

UTAH STATE UNIVERSITY

I. Station: Utah Agricultural Experiment Station, Logan, Utah

II. Project Title: The development of breeding techniques and selection criteria for improvement of economically important characteristics in Hereford and Shorthorn cattle

III. Personnel:

Experiment Station:

James A. Bennett and Doyle J. Matthews

U. S. Department of Agriculture

R. T. Clark, Coordinator

C. E. Shelby

IV. Nature and Extent of Work Done This Year:

The development of lines of Hereford and Shorthorn cattle through a system of mild inbreeding accompanied by selection was continued according to plan.

Additional tests were made with tritium and NAAP (N-acetyl 4-aminoantipyrène) to determine their value for estimating body composition in live cattle. The results of these studies combined with past studies indicate that tritium is somewhat more accurate than NAAP for estimating body composition. A correlation value of 0.79 was found between body fat estimates based on tritium and those based on ether extract determination of the 9th, 10th, and 11th rib cut area. While this correlation is rather high and significant, it falls short of the level desired for an accurate method for experimental cattle studies. Some animals gave abnormal readings with tritium as well as with NAAP. Fewer abnormal values were obtained with tritium than with NAAP. Most of these probably resulted from improper injection technique, but it is felt that all of them did not arise from this cause. No explanation was found for most of the deviates.

Very close agreement was found between fat estimation of the 9th, 10th, and 11th rib cut based on specific gravity and ether extract determination ($r=0.92$). The specific gravity method is rapid and appears to be highly accurate if properly done. It was found that accuracy in weighing to the nearest one-hundredth of a pound is desirable. It was also found that the weight under water should be taken very quickly after immersion because the weight increased significantly as the time under water increased.

Glutamic acid determinations in relation to the dwarf condition were made on animals of various genotypes. Considerable difficulty was encountered with the microbiological assay technique in many of the samples. Some

of the urine samples seemed to be strongly buffered which had an effect on the growth of the microorganisms. Attention is being given to developing a direct quantitative chemical determination for glutamic acid.

V. Summary of Progress and Conclusions to Date:

The development of inbred lines of Hereford and Shorthorn cattle is proceeding. Production in these lines is reasonably satisfactory. Inbreeding levels are not yet high, but are gradually rising. Milk production is evidently higher in the Shorthorns than in the Herefords as judged from weaning weights which have regularly been heavier in the Shorthorns. The adjustment factors developed for standardizing weaning weight appear to be reliable. Tritium oxide and NAAP give estimates of body composition that are highly correlated to specific gravity estimates and chemical determinations. Greater accuracy than was obtained with these methods is desired, however.

Glutamic acid apparently is present in greater relative quantities in the urine of dwarf than in normal cattle. There is need for a direct quantitative chemical measure of glutamic acid that would be more rapid and less subject to interference by other substances present in the urine than microbiological assay.

Application of Findings

Studies in the development of lines of cattle will give information on the value of mild inbreeding accompanied by selection for increasing productiveness. It is felt that to date the project has made available to cattlemen in the state bulls of high value based on utility factors.

Adjustment factors developed will be helpful in improving accuracy of selection in similar herds of comparable environment.

Results of the biochemical studies of body fluids in cattle have given information that should be helpful in providing an understanding of the basic causes of differences in growth rate and other productive factors in cattle.

VI. Work Planned for the Future:

1. Continue development of lines of Hereford and Shorthorn cattle.
2. Attempt to develop a simple and more accurate method of estimating body composition in live cattle.
3. Develop a direct quantitative method of measuring glutamic acid.

4. Continue biochemical studies of body fluids in an attempt to find methods of differentiating genotypes for the dwarf condition and productive ability in cattle.
5. Encourage and assist the extension livestock specialist in developing a state program in performance testing.

VII. Publications and Manuscripts:

Shumway, R. Phil

1959. Studies of body fat composition of live steers using tritium, antipyrine and N-acetyl 4-aminoantipyrine dilution methods. Ph. D. Thesis. Utah State University. Logan.

Utah Agricultural Experiment Station

1959. Performance testing results. A field day report. Utah Agr. Expt. Sta. and Ext. Serv. Mimeog. Rpt.

Utah Agricultural Experiment Station

1959. Growth in young beef bulls. (In manuscript.)

Utah Agricultural Experiment Station

1959. Weight variations in cattle. (In manuscript.)

Cattle Inventory

PROJECT SUMMARY

Purebred

Utah Agricultural Experiment Station

Breed	Hereford	Hereford	Shorthorn
Line	I	II	I
Station	Logan	Panguitch	Logan
Bulls (12 mos. or over)	4	8	6
Cows (2 yrs. or over)			
Heifers, yearlings	14	21	10
Bull calves	9	22	14
Heifer calves	12	26	13
Percentage used for breeding project	90	100	90
Estimated cash value	\$11,925	\$23,360	\$13,395

Young Animals on Feed

Purebred

	Hereford Line I	Hereford Line II	Shorthorn Line I
	Individually fed	Group fed	Individually fed
	fed	fed	fed
Bulls	6	8	5
Heifers	12	21	9
Steers	3	11	

Utah Agricultural Experiment Station
Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Land - Panguitch	155 acres	\$31,000	90
Land - Logan	269 acres	80,000	80
Shed, yards	5 units	60,000	90
Metabolism building	1 unit	60,000	5
Laboratory equipment --chemical	-	1,500	100

Cow Production Data

Breed	Hereford		Hereford		Shorthorn							
Line	I		II		I							
Cows bred	28		50		25							
Calves born												
Alive	25		45		20							
Dead	1		2		2							
Total	26		47		22							
Calves weaned	24		41		18							
% calf crop ^{1/}												
Birth	93		94		88							
Weaning	86		82		72							
	Bulls		Heifers		Bulls		Heifers					
	No.	Av.	No.	Av.	No.	Av.	No.	Av.				
Average:												
Birth weight	9	70	15	66	22	68	25	61	8	68	14	64
Weaning age	207		206		191		201		201		206	
Weaning weight	9	428	15	393	19	349	22	344	6	474	12	415
Adj. weaning wt. - 190 days	411		426		379		392		482		436	
Weaning score												
Cond.	9	2.0	14	1.8	19	2.1	22	2.0	6	1.3	12	1.6
Conf.	9	2.4	14	2.3	19	3.0	22	2.7	6	1.4	12	1.7

^{1/} Based on number of cows placed in breeding pasture minus those removed for some cause other than being barren. If a cow that is removed is barren she is counted in the "cows bred" group.

Feed-lot Performance Utah Agricultural Experiment Station

	Individually Fed			
Breed	Hereford	Hereford		Shorthorn
Line	I	II		I
Sex	Male	Male		Male
Number on test	6	8		5
Average:				
Age on test	237	221		231
Initial weight	506	508		526
Initial score				
Cond.	1.9	1.9		1.3
Conf.	2.3	2.6		1.4
Days on test	127	113		125
Average total gain	275	253		294
Average daily gain	2.17	2.24		2.35
Efficiency of				
feed utilization				
Lbs. TDN/100 Lbs. gain	447	451		455
or				
Lbs. gain/100 lbs. TDN	22.37	22.17		21.97
Average final weight	781	761		821
	Group Fed (Limited Concentrates)			
Breed	Hereford	Hereford	Hereford	Shorthorn
Line	I	II	II	I
Sex	Heifers	Heifers	Steers	Heifers
Number on test	12	21	11	9
Average				
Age on test	206	201	191	206
Initial weight	386	350	285	414
Initial score				
Cond.	-	-	-	-
Conf.	-	-	-	-
Days on test	231	210	237	231
Average total gain	201	263	334	242
Average daily gain	0.87	1.26	1.41	1.04
Efficiency of				
feed utilization				
Lbs. TDN/100 Lbs. gain	-	-	-	-
or				
Lbs. gain/100 lbs. TDN	-	-	-	-
Average final weight	587	613	619	656

STATE COLLEGE OF WASHINGTON

- I. Station: Washington Agricultural Experiment Station, Pullman, Washington
- II. Project Title: Improvement of beef cattle by selection and mild inbreeding within lines of the Hereford, Angus, and Shorthorn breeds
- III. Personnel:
- Experiment Station:
C. C. O'Mary, M. E. Ensminger
- Graduate Students:
Thomas L. Brown, Don Vance
- U. S. Department of Agriculture:
R. T. Clark, Coordinator
C. E. Shelby
- IV. Nature and Extent of Work Done This Year:
1. Body Measurements of Cows and Their Relationship to 180-Day Adjusted Weights of Calves

Table 1.--Analysis of variance for simple linear correlation and regression coefficients between various body measurements of dam and weaning weight (adjusted to 180 days) of calf

Variables	Mean	Coefficient of:	
		b y_{x_i}	r y_{x_i}
y (180-day weaning weight)	353.75 lb.	...	...
x ₁ (length of foreshank)	18.05 cm.	19.86	.46*
x ₂ (forearm circumference)	44.80 cm.	7.13	.48*
x ₃ (length of pelvis)	45.25 cm.	7.11	.46*
x ₄ (foreshank circumference)	13.15 cm.	21.71	.29
x ₅ (length of foreleg)	51.60 cm.	2.60	.23
x ₆ (ht. at top of shoulder)	105.95 cm.	7.84	.25
x ₇ (heart girth)	186.65 cm.	1.05	.17
x ₈ (point of shoulder to hock)	100.10 cm.	1.58	.15
x ₉ (point of shoulder to pin)	143.35 cm.	2.53	.33
x ₁₀ (width at hooks)	48.35 cm.	3.49	.31
x ₁₁ (width at pins)	17.70 cm.	2.46	.16
x ₁₂ (chest depth)	65.40 cm.	5.13	.27
x ₁₃ (hooks to stifle)	39.50 cm.	0.32	.00
x ₁₄ (coupling)	25.15 cm.	5.52	.39
x ₁₅ (skin thickness)	1.18 mm.	1.07	.21

* P < .05.

Table 2.--Calculations for determining correlation and regression coefficients between average cow weights (X) and weaning weights (y) (adjusted to 180 days) of calves

Breed	df	X^2	xy	y^2	Coefficient of:		df	Deviation from Regression	
					b	r		$\frac{\Sigma y^2 - (\Sigma y)^2}{\Sigma X^2}$	Mean Square
Shorthorn	12	177,574	21,182	33,810	0.1193	.273	11	31,283	2844
Hereford	14	407,596	62,440	33,182	0.1532	.536*	13	23,678	1821
Angus	19	174,029	33,468	38,904	0.1923	.406	18	32,468	1804
Within	..	..	..	..	..	..	42	87,429	2082
Reg. Coef.	..	..	..	..	..	..	2	408	204
Common	45	759,199	117,090	105,896	0.1542	.415	44	87,837	1996
Adj. Means	2	188,140	56,282	17.046	0.2991	..	2	210	105
Total	47	947,399	173,372	122,942	0.1769	.509**	46	91,214	198

* P < .05.

** P < .01.

Only three measurements of the dam were significantly correlated to the 180-day adjusted weaning weights of calves. These were length of fore-shank, forearm circumference, and length of pelvis (rump). A multiple (R) of these factors was determined to be .906.

2. Relationship of Classification Score of Dam and Adjusted 180-Day Weight of Calves

Cows were scored by two of us (C. C. O'Mary and Thomas L. Brown) and later classified by a representative of the Angus Association. An r of .64 ($P < .01$) was obtained between our scores and the classification score. However, the correlations between our score of dam and 180-day adjusted weaning weight of calf was 0.00 and between the classifier's score and 180-day adjusted weaning weight was 0.06.

3. Relationship Between Cow Weights and Weaning Weights of Calves (Adjusted to 180-Day--see Table 2).

4. Weights of Calves at Different Ages

Hereford and Shorthorn calves were weighed on 6/20/58, 8/5/58, and 9/29/58. The 180-day adjusted weights were calculated from each of these dates. The 180-day adjusted weights from the latter two dates were reasonably close as shown in the following table, but calves (except Shorthorn females) weighed at the earlier date of 6/20/58, had lighter adjusted weights.

Table 3.--Adjusted 180-day weights

		Adjusted 180-Day Weights From:		
		6/20	8/5	9/29
	(No.)	(Lbs.)	(Lbs.)	(Lbs.)
male	6	368.8	423.7	427.7
Hereford				
female	10	337.3	371.9	376.6
male	5	348.0	368.0	368.6
Shorthorn				
female	7	358.9	353.3	362.7

The Angus calves were weighed on 9/29 and an adjustment was made to 243 days (a starting time on one experiment). Actual weights were taken at 243 days. These figures are shown in Table 4.

Table 4.--A comparison of predicted weights and actual weights on Angus calves.

	No.	Predicted Weight (Lbs.)	Actual Weight (Lbs.)
		243 Days	243 Days
Males	7	494.7	500.3
Females	11	434.0	439.0

5. Feed-lot Performance

Table 5.--Performance testing on a time constant of 150 days

Chain No.	Tattoo	Breed	Grade	ADG	FE/100 Lbs.
<u>Males Individually Fed</u>					
1	708	A	Ch	1.89	539.1
10	718	A	Ch +	1.85	695.5
29	778	A	Ch -	1.73	716.9
98	698	A	Ch +	2.14	495.8
166	678	A	Ch +	1.94	788.8
373	688	A	Ch -	2.18	743.7
395	618	A	Ch	2.15	572.4
8	48	H	G	2.19	576.3
35	58	H	Ch-	2.39	581.8
91	88	H	G +	2.45	632.8
11	438	S	Ch	2.49	651.5
25	418	S	Ch-	2.28	711.7
42	358	S	Ch	2.43	656.7
62	348	S	Ch	2.36	677.8
67	308	S	G	2.39	566.0
<u>Females Individually Fed</u>					
315	98	H	G	1.17	1,023.6
334	38	H	G	1.57	592.2
363	388	S	G	1.51	734.4
365	378	S	Ch-	1.48	823.6
381	728	A	Ch +	1.62	795.3
384	658	A	G +	1.21	860.7
389	738	A	Ch +	1.68	738.1
<u>Females Group Fed</u>					
393	18	H	Ch	1.83	)
13	28	H	Ch	1.80	)
78	148	H	Ch +	1.69	)
191	458	S	Ch-	1.85	) 810.9
26	448	S	Ch	2.13	)
44	338	S	Ch	2.02	)
23	468	S	G	2.37	)
14	328	S	Ch	1.77	)
<u>Females Group Fed</u>					
68	608	A	G +	1.31	)
374	758	A	Ch-	1.62	)
18	648	A	Ch +	1.69	)
96	748	A	Ch-	1.56	) 810.8
97	788	A	G-	1.65	)
65	668	A	Ch +	1.61	)
131	768	A	Ch-	1.69	)
66	638	A	Ch +	1.56	)

6. Records of Cows in Herds

Cow record cards are being kept. The production records on the Angus cows (with 2 or more records) have been adjusted for sex of calf, age of calf, and age of dam, and cows have been rated on their lifetime average adjusted weights. The variation ranged from 351.6 lbs. to 443.3 lbs. These records will be used as one of the bases of culling. Records are also being kept on the Hereford and Shorthorn cows.

V. Summary of Progress and Conclusions to Date:

Females on performance test are used as replacement stock. By use of the better-performing animals the over-all performance of the herd should be improved. This is presuming that the gain will not be lost by use of a poorer-doing bull.

Some of the measurements appear promising as future possibilities in making selection, but further work will be needed on this.

Application of Findings

Continued use of records helps make selections for replacements and culling more accurate. An all-pelleted ration continues to give good results, saves labor, and helps make feed efficiency records more readily obtainable.

VI. Work Planned for the Future:

Repeat each of the following phases:

1. Continue to get calf weights at different time intervals to determine accuracy of adjustment factors
2. Get more cow and calf measurements to determine relationships
3. Continue to make use of lifetime cow production records
4. Compare individual vs. group feeding.
5. Compare time constant, age constant, and weight constant performance records of beef calves

VII. Publications and Manuscripts:

Brown, Thomas L.

1959. The influence of certain body measurements, weights and grades of beef cows on calf performance. M. S. Thesis. State Col. of Wash. Pullman.

O'Mary, C. C.

1959. Cow weights and measurements and their relation to weaning weight of calves. Fifth Annual Beef Cattle Day. State Col. of Wash. Pullman.

O'Mary, C. C.

1959. **Inbreeding**-- a breeding system for finding the good and bad traits of cattle. Breeder's Gazette 124(6):11.

Cattle Inventory

PROJECT SUMMARY

Purebreds

Washington Agricultural Experiment Station

Breed	Angus	Hereford	Shorthorn
Line	Eileenmere	F Baca Elation	N-Bar Gift
Station	Pullman	Pullman	Pullman
Bulls (12 mos. or over)	2	2	3
Cows (2 yrs. or over)	27	27	25
Heifers, yearlings	5	13	8
Bull calves	8	5	9
Heifer calves	11	10	7
Percentage used for breeding project	100	100	100
Estimated cash value	\$20,200	\$21,300	\$16,600
Grades	None	None	None

Young Animals on Feed

	Angus		Hereford		Shorthorn	
	Number individually fed	Number group fed	Number individually fed	Number group fed	Number individually fed	Number group fed
Bulls	7	0	3	0	5	0
Heifers	3	8	2	3	2	5

Washington Agricultural Experiment Station
Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Pasture	102 acres	\$35,700	50
Paving feed area at winter quarters		2,500	100
Partitions in feed- lot area	1	50	100
Scale (for weighing feed)	1	85	50
New animal breeding laboratory (well equipped)	1	50,000	100
Cattle laboratory annex (50% for dwarf study)	1	25,000	50

Cow Production Data^{1/}

Washington Agricultural Experiment Station

Breed	Angus				Hereford				Shorthorn			
Line	1				2				3			
Cows bred	22				22				20			
Calves born												
Alive	19				18				17			
Dead	1				2				2			
Total	20				20				19			
Calves weaned	19				18				17			
% calf crop ^{2/}												
Birth	90.0				90.0				95.0			
Weaning	86.4				81.4				85.0			

1/ 1958 calves.

2/ Calculated as a percent of cows bred. Those cows open at the end of breeding season were marketed.

3/ Score based on: 16 = fancy, 13 = choice, 10 = good, and 7 = medium.

UNIVERSITY OF WYOMING

I. Station: Wyoming Agricultural Experiment Station, Laramie, Wyoming, and Gillette Experiment Station, Gillette, Wyoming

II. Project Titles:

W. S. 655 Criteria for improving effectiveness of selection in beef cattle

W. S. 610 A study of the significance of head form in beef cattle

III. Personnel:

Experiment Station:

P. O. Stratton, G. E. Nelms, C. O. Schoonover, C. P. Stroble, J. O. Tucker, M. C. Trueblood, permanent and temporary farm laborers, and graduate students

U. S. Department of Agriculture

R. T. Clark, Coordinator

C. E. Shelby

IV. and V. Nature and Extent of Work Done This Year, and Summary of Progress and Conclusions to Date:

Project W. S. 655

Performance data were collected as called for in the project. Records of growth and development of 135 Hereford, Shorthorn, and Angus calves for the years 1953-55 were analyzed. The possibility of increasing efficiency of selection for future performance at weaning was tested by the analyses of variance of the multiple regressions of three measures of future performance, total gain, final weight, and final score of 13 independent variables (Table 1). Each of the regression equations was statistically significant.

The following generalities were drawn from this study:

1. Males tend to gain faster on performance tests and weigh heavier at end of test, but score lower than the females at end of test.
2. Year differences have a significant effect on total gain and final weight. Final scores are almost entirely independent of yearly differences.
3. Both younger cows and older cows are capable of producing calves whose feed test performances excel those of calves from cows in the prime of life.

Table 1.--Regressions of total gain, final weight, and final score

Variable	Total Gain		Final Weight		Final Score	
	B _i	b _i	B _i	b _i	B _i	b _i
X ₁ Sex	-0.48	- 61.96**	-0.34	- 73.47**	+0.05	+ 1.75
X ₂ Year	-1.84	-156.06*	-1.83	-258.34**	-0.72	-17.84
X ₃ Year ²	+1.71	+ 17.65*	+1.84	+ 31.55**	+0.67	+ 2.02
X ₄ Age of dam	-0.31	- 7.25	-0.15	- 5.87**	-0.20	- 1.36
X ₅ Age of dam ²	+0.28	+ 0.44	+0.12	+ 0.31**	+0.18	+ 1.03
X ₆ Birth weight	+0.34	+ 2.10**	+0.22	+ 2.19**	-0.02	- 0.04
X ₇ Weaning weight	+0.24	+ 0.23	+0.58	+ 0.92**	+0.12	+ 0.03
X ₈ Age at weaning	-0.00	- 0.00	-0.04	- 0.18**	-0.00	- 0.00
X ₉ Weaning score	+0.04	+ 0.48	-0.02	- 0.36	+0.17	+ 0.59**
X ₁₀ Shoulder height	+0.29	+ 1.16**	+0.22	+ 1.46**	+0.08	+ 0.10
X ₁₁ Shoulder width	+0.09	+ 0.58	+0.12	+ 1.37**	-0.02	- 0.04
X ₁₂ Chest girth	-0.24	- 0.60	-0.12	- 0.47**	-0.02	- 0.01
X ₁₃ Chest depth	-0.16	- 1.12	-0.01	- 0.17	-0.08	- 0.15

4. Bone-to-bone measurements at weaning are indicative of future size. Measurements at weaning of the development of muscle and fat may have some small and positive relationship with future development.
5. Birth weight and weaning weight seem to influence final weight. Birth weight exerts an influence on performance test gains. In general, those calves which are heavier at birth and weaning tend to make more rapid gains during performance tests, and are heavier at end of tests.
6. Age at weaning has almost no effect upon future performance, due no doubt in part to the small variability in age at weaning.
7. Weaning score is of value only as it is capable of predicting future scores.

The relationship of postweaning feed performance test records collected from 357 calves of five lines of breeding were studied. Carcass measurements from 94 head of these animals were studied and related to postweaning performance. Gross correlation coefficients are shown by sex in Table 2, where line and year effect were removed.

This season our program continued and to date we have 16 cows that have passed their first heat period following insemination from semen collected this year. In addition, all the 1958 replacement heifers will be bred A.I. on first heat after June 13, and rebred A.I. if necessary upon return.

Identical twins have been used in a study to determine the effect of castration on carcass merit. One of each set has been castrated at about six months of age, and both slaughtered at about 13 months. Two pair of Holstein calves have been slaughtered (results shown below); another pair of Hereford calves will be slaughtered mid-summer. Complete separation of the left side of the carcass as to bone, lean and fat has been completed on the Holsteins.

	Pair I		Pair II	
	♂	Steer	♂	Steer
Live weight	661#	690#	772#	793#
Cold carcass	401#	394#	406#	436#
Dressing percent	60.66	57.19	52.6	54.98
Weight left side	198#	194#	201#	215#
Lean	136.0#	117.5#	139#	123.5#
Bone	36.0#	35.0#	35.5#	38.0#
Fat	19.0#	37.0#	23.8#	49.0#
Cutting loss	7.0#	4.5#	2.7%	4.5#
Age (days)	395	395	409	409
Length body	113.2	113.6	117.6	117.8
Length leg	74.1	74.6	74.3	77.0
Length loin	61.0	61.5	63.0	63.5
Depth round	28.5	26.7	29.1	30.0
Area eye muscle	7.56	7.06	9.38	7.38

Table 2.--Gross correlation coefficients by sex where line and year effect were removed

	Int. Wt.	Total Gain	Eff. of Feed	Score	Heart Girth	Wither Height	Chest Depth	Shoulder Width
Total gain								
Male	.15*			.28**	.54**	.55**	.94**	.69**
Female	.27**			.25**	.50**	.53**	.43**	.55**
Eff. of feed								
Male	.21	-.53**			.26**	.18**	.19**	.15**
Final weight								
Male	.21	-.53**	-.03					
Female		.15*						

Gross correlation coefficients of total gain and final weight to carcass measurement on 65 bulls and 29 heifers are shown in Table 3.

Table 3.--Gross correlation coefficients of total gain and final weight to carcass measurement on 65 bulls and 29 heifers

	Depth Round	Body Length	Loin Length	Area Rib-eye
Total gain	.33**	.61**	.55**	.58**
Final weight	.60**	.98**	.93**	.79**

In an attempt to determine the accuracy of prediction of total gain of heifers and bulls at 112 and 140 days on feed as compared to 168 days, the following results were obtained. Actual performance values were more accurate in prediction than was rank within group. Data on total gain for 112 and 140 days accounted for 83 and 92 percent of the variability at 168 days for bull calves, and 77 and 87 percent for heifer calves, respectively.

Preliminary results of the radiographs of left metacarpal bone at birth, weaning, and yearling age, indicate that a live measurement of the bone is reasonably accurate when related to the radiograph. Also, as an estimator of carcass merit when carcass weight is held constant, there was a negative relationship of bone volume to area of rib-eye and depth of round. Age was negatively associated to area of rib-eye and depth of round also.

There are twenty calves on the ground this spring by the Hereford bull used at Wyoming in cooperation with the Oregon station. The A.I. work initiated last spring was far from successful; however, we have four calves in the Angus and Shorthorn herd by semen collected from top-performing bulls post-slaughter. Two of the calves were produced by spermatazoa from the epididymis frozen successfully.

Preliminary results of carcass measurements show that a combination of body length, area of rib-eye, and depth of round is the best indicator of total lean meat in the carcass of those measurements studied at Wyoming. A summary of 1958-59 data collected postslaughter by breed and sex is shown below:

Bulls									
	No.	Age in Days	Live Weight	Cold Carcass Wt.	Length Body (Cm.)	Length Leg (Cm.)	Length Loin (Cm.)	Depth Round (Cm.)	Area Eye (Sq. In.)
Hereford (L)	4	391	825	490	112.5	69.8	58.1	31.8	9.91
Hereford (G)	11	376	613	341	103.3	65.6	55.2	25.2	
Angus	4	383	762	450	109.7	65.2	57.4	29.0	10.13
Shorthorn	3	375	845	519	111.9	69.9	58.7	31.9	8.83
Steers									
Hereford (L)	5	672	1136	694	121.2	75.0	66.2	36.9	10.44
Angus	3	398	776	469	110.2	68.8	57.7	29.9	9.69
Angus	5	696	1098	702	119.9	71.4	63.3	35.1	10.91
Shorthorn	4	680	1201	766	125.5	74.2	65.9	36.3	10.30
Females									
Hereford (L)	2	399	506	284	101.2	64.4	55.8	20.2	5.13
Hereford (G)	3	382	598	335	103.7	66.8	55.7	25.1	
Shorthorn	2	425	696	416	108.2	66.8	59.0	24.7	7.41
× Bred	3	389	657	393	107.0	65.5	60.7	25.2	7.32

Project W. S. 610 A study of the significance of head form in beef cattle

A carrier bull mated to 28 heifers selected on severity of head form produced two abnormal dwarf-appearing calves. Weaning weight of the balance of the calves was below that of any of the parent lines. This study indicated that dwarfism is related to head form and that the dwarf complex may affect general growth.

Application of Findings

When uniform postweaning nutritional levels are provided, the response in growth and development occurs inversely to the preweaning growth pattern.

Relative bone-size measurements at weaning are capable of predicting future size and weight, but fail to indicate future scores. Relative measurements of muscle, fat, and bone at weaning are of negative influence on future growth, especially final weight.

Table 2.--Gross correlation coefficients by sex where line and year effect were removed

	Int. Wt.	Total Gain	Eff. of Feed	Score	Heart Girth	Wither Height	Chest Depth	Shoulder Width
Total gain								
Male	.15*			.28**	.54**	.55**	.94**	.69**
Female	.27**			.25**	.50**			
Eff. of feed								
Male	.21	-.53**			.26**	.18**	.19**	.15**
Final weight								
Male		.22**	-.03					
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In an attempt to determine the accuracy of prediction of total gain of heifers and bulls at 112 and 140 days on feed as compared to 163 days, the following results were obtained. Actual performance values were more accurate in prediction than was rank within group. Data on total gain for 112 and 140 days accounted for 83 and 92 percent of the variability at 163 days for bull calves, and 77 and 67 percent for heifer calves, respectively.

Preliminary results of the radiographs of left metacarpal bone at birth, weaning, and yearling age, indicate that a live measurement of the bone is reasonably accurate when related to the radiograph. Also, as an estimator of carcass merit when carcass weight is held constant, there was a negative relationship of bone volume to area of rib-eye and depth of round. Age was negatively associated to area of rib-eye and depth of round also.

There are twenty calves on the ground this spring by the Hereford bull used at Wyoming in cooperation with the Oregon station. The A. I. work initiated last spring was far from successful; however, we have four calves in the Angus and Shorthorn herd by semen collected from top-performing bulls postslaughter. Two of the calves were produced by spermatazoa from the epididymis frozen successfully.

Scores of condition and conformation at weaning are not useful in determining future growth but are the only indicators for future scores.

Only a slight loss in measuring variation in feed-lot performance would result in the reduction of a feed-lot period from 168 days to 140 days.

VI. Work Planned for the Future:

Extended efforts toward carcass studies will be our main objective. A sire-progeny carcass comparison will be possible next year.

Intense work on body measurements taken during the first week following birth as a possible indicator of meat type will be initiated. Also, certain blood factors will be investigated early in life as possible selection tools (serum protein fractionation, total protein, creatinine, and certain enzymes.)

VII. Publications and Manuscripts:

Hallman, L. E.

1959. Factors affecting postweaning performance in beef cattle. M. S. Thesis. University of Wyoming. Laramie.

Sabin, S. W., F. O. Stratton, and N. W. Hilston

1958. Growth from birth to weaning in beef calves as an indication of future performance. (Abs.) J. Anim. Sci. 17(4):1147.

Schoonover, C. O., and P. O. Stratton

1958. The relationship of head form to economic factors in Hereford heifers. Amer. Soc. Anim. Prod. West. Sect. Proc. 9:XLVI-1-6.

Stratton, P. O.

1959. Short cut to meat-type steers? Farm J. May 1959:

Cattle Inventory
Purebred

PROJECT SUMMARY
Wyoming Agricultural Experiment Station

Breed	Angus	Short-horn	Here-ford	Here-ford	Hereford
Line					Dryer (Grade)
Station	Laramie	Laramie	Laramie	Gillette	Laramie
Bulls (12 mos. or over)	2	2	2	4	0
Cows (2 yrs. or over)	31	31	30	32	9
Heifers, yearling	6	7	4	3	5
Steers, yearling	6	5	1	0	4
Bull calves	13	15	18	17	4
Heifer calves	12	10	10	13	4
Percentage used for breeding project	100	100	100	100	100
Estimated cash value	\$12,800	\$13,150	\$12,075	\$11,850	\$3,525

Young Animals on Feed
Purebred

	Hereford		Shorthorn		Angus	
	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed
Bulls	22	0	9	0	11	0
Heifers	0	18	0	10	0	3
Steers	0	0	0	0	4	0
Grade						
Bulls	3					
Heifers		5				

Land, Physical Facilities, and Equipment Used

Item	Number	Actual Cash Value	Percentage Used for Breeding Project
Beef shed and trench silo	1 each	\$5,840.00	100
Fencing		500.00	100
Machinery leases		2,220.00	60
Meats laboratory equipment		1,006.37	60
Photo equipment		19.95	60
Livestock (identical twins)		972.00	100
Gas heater		32.50	100
Animal scale	1 only	1,650.00	90
Loading attachment to tractor	1 only	1,487.43	80
Office equipment		124.23	100
Farm equipment		130.79	60
Truck, 2-ton	1 only	3,399.19	50

Cow Production Data Wyoming Agricultural Experiment Station

Breed	Angus		Shorthorn		Hereford	
Line	Laramie		Laramie		Laramie	
Cows bred	28		25		25	
Calves born						
Alive	24		20		16	
Dead	0		0		0	
Total	24		20		16	
Calves weaned	23		19		13	
% calf crop						
Birth: Cow bred/calves born	86		80		64	
Weaning: Cow bred/ calves weaned	82		76		52	

Cow Production Data Wyoming Agricultural Experiment Station

Breed	Hereford		Hereford	
Line	Dryer		Gillette	
Cows bred	9		34	
Calves born				
Alive	9		32	
Dead	0		2	
Total	9		34	
Calves weaned	9		32	
% calf crop				
Birth: Cow bred/ calves born	100		94	
Weaning: Cow red/ calves weaned	100		94	
	Bulls		Heifers	
	No.	Av.	No.	Av.
Average:				
Birth weight	3	72	6	69
Weaning age		186		190
Weaning weight	3	325	6	322
Adj. weaning wt.- 120 days		314		311
Weaning score				
Cond.	3	3.2	6	3.0

Feed-lot Performance

Breed	Angus			Hereford		Hereford		Hereford		Shorthorn	
Line	Laramie			Laramie		Dryer		Gillette		Laramie	
Sex	F	S	M	F	M	F	M	F	M	F	M
Number on test	8	4	11	7	6	5	3	11	16	10	9
Average											
Age on test	188	197	196	200	195	199	193	193	202	201	189
Initial weight	322	400	412	350	374	328	330	340	382	426	395
Initial score											
Conf.	4.6	5.0	5.4	2.6	3.7	3.0	3.2	4.5	4.8	6.2	5.5
Days on test	165	165	165	165	165	165	165	168	168	165	165
Gain per head											
Total	211	329	345	256	394	256	402	219	314	254	393
Average	1.28	1.99	2.09	1.55	2.39	1.55	2.43	1.30	1.87	1.54	2.38
Efficiency of feed utilization											
lbs. TDN/100 lbs. gain	-	495	455	-	426	-	377	-	401	-	457
Final weight	533	729	757	606	768	584	732	559	696	680	788
Final score											
Conf.	4.2	4.4	5.2	2.8	3.7	3.5	3.5	5.6	5.9	4.8	5.4

Arizona - Dr. Pahnish:

Ours is a cooperative project, one phase with two ranches fifty miles out of Tucson, and the other with the Apache Indian Tribe at San Carlos. In both cases we are working with purebred Hereford livestock.

At Empire and Arivaca ranches the program has been in operation for quite a number of years and was the initial Arizona project under W-1. We are continuing the accumulation of data and the preparation of data now designed for IBM processing and the completion of statistical analyses. Pre-weaning data were obtained last year. We are now preparing to analyze post-weaning data. Male and female calves are carried to fall yearling age.

In the cooperation with the Apache Tribal Herd we used two bulls from each of four Miles City lines. Those bulls are being used in comparison with four additional bulls produced in the Apache Tribal Herd, unrelated and selected by visual appraisal. Information collected is: birth dates and weights; weaning, 12-, 18-, and 24-month weights; conformation and condition scores; liver and blood samples. Information on relatively unselected bulls and heifers has been collected through the age of 24 months at four collection periods. The second calf crop is through 12 months of age at the present time--18-month data will be collected this fall.

Liver and blood samples have been analyzed to date. Currently, we are in the process of running preliminary statistical analyses.

We modified the program some in that the first of the female progeny produced went in as replacements this year--went in unselected. We have randomized those by sires among the two breeding pastures in which we have used two bulls produced on the Apache Reservation for the purpose of getting some indication of productivity of females produced by Miles City sires.

In the work with the Apaches one problem was the low calf crop--60 to 65 percent based on live calves born divided by the total number of cows bred. Since the program has been in operation, the calf crop has increased materially--first year 68 percent (at birth), second year 74 percent, third year 82 percent.

In the analysis of chemical data we have concentrated on the effects of age on vitamin A and carotene levels. There was a significant effect on vitamin A storage at weaning time. There was no appreciable age effect on plasma vitamin A at any age.

In the future in the Empire and Arivaca cooperation emphasis will be placed on the analysis of the yearling data for evaluation of environmental effects on postweaning traits.

In the Apache herd the existing procedure will be continued. Emphasis will be placed on preliminary analysis of accumulated data to determine what the general picture is up to this time with regard to metabolic functions and how they tie in with production traits.

California - Dr. Rollins:

We have an experiment in which we are testing bulls for rate and efficiency of gain and earliness of maturity which has been going on for several years. We test the bulls for rate of gain from weaning to yearling age on a growing ration and at one year of age put them in the feed lot on feeding ration individually fed. At the end of the time we send out four bulls a year for progeny testing--one bull from each group to a cooperator for within-ranch testing. At the end we purchase ten progeny from each sire and treat them the same as we had treated their sires. We have completed 18 sire progeny groups and have six more coming in, which will complete the study in 1961.

Can we select these bulls on the growing ration? We fed essentially hay and some concentrate. We limit the gain to about 1 pound or 1.25 pounds per day. To date on the basis of information gathered it looks like we have been successful in selecting bulls that will sire faster, more efficient-gaining animals on this limited feed period. It looks as though the final weight of the steer group indicates the better bull.

The most of our cattle at Davis are in our inbred Rover line. The level of inbreeding of the younger stock is between 20 and 25 percent. In this line only one anomalous trait has appeared--a double cervix. It looks like a recessive gene segregate. We have not been able to make test matings, but judging from the incidence in our herd and the range herd and a Nevada herd there are quite significant differences in the percentage of the anomaly.

We have been cooperating with the Colorado and Mississippi stations in making the comparisons with the Rover line with the Brae Arden line of Colorado. The Rover line has been compared with other Colorado lines, but Brae Arden is the one we are most interested in. Three inbred bulls from the Rover line have been used in Colorado and at Mississippi, and three bulls at Davis. Three bulls from the Brae Arden line have been used at each of these places, either through natural service or artificial insemination. The conditions for the test were not standardized. However, weaning weight

we can compare at the three locations and for this purpose it is good in that the locations are quite different. We will have calf crops from the three stations for three years.

Originally we wanted to use three bulls at three different places, but we ran into trouble so we ended up with three different bulls from the same lines at three different places. But it is good in the sense that we will end up with somewhere between five or six bulls from each line involved at the three locations, and I think the averages we get between the two lines at the three places will have some meaning although they are not as good as the originally planned test. We will get some idea from this although the conditions are not exactly controlled.

Looking at the averages for the first year, the Brae Arden line for weaning weight was superior to the Rover line at all three stations. I should add this fact, at Mississippi we have a top-cross situation--the inbred Brae Arden-Rover bulls are being used on unrelated stock. In Colorado the inbred bulls are being used on line-cross cows. California bulls are being used on Rover cows. There is no negative regression on inbreeding in weaning weight based on a varying amount or degree. The actual estimate is positive although not significant.

Another aspect resulting from this line crossing with the Brae Arden line, we have these line-cross bulls and are farming out these bulls and inbred bulls to cooperators. We are sending out several pairs and we want to see how they compare in such ways as evidence of hybrid vigor of calves, percentage of calf crop; also, is there any observable difference in uniformity of calf crop. We will attempt to carry out carcass analyses from the animals coming from this. We are going to try to cooperate with producer, feed-lot operator, and packer.

We have a study going on--on a selection index based on weaning weight coming from the California Production Testing program which is now being sponsored by the producers. These data will be worked on next year.

On our experience with artificial insemination in the work with Colorado, we used artificial insemination from two of their bulls. We have the conditions for doing this at Davis. We used semen six months old from one bull and from another the semen was three months old. Thirty percent success from the 6-month semen, 54 percent from the 3-month semen, resulted. The cows had good production records but the inseminator found some difficulty with the cows due to minor infections, etc. We are going to check the cows earlier another year.

Dr. Cassard:

At what age do the progeny steers come back?

Dr. Rollins:

Six to 8 months--weaning age.

Dr. Clark:

Would you describe your off-station trial begun with your private breeders.

Dr. Rollins:

Crossbreeding with the Charollais, we started an experiment where we are comparing Hereford with Angus, and Hereford with Charollais. We wanted to compare all of the British breeds--Hereford, Angus, Shorthorn, etc. We had to do this with cooperators so we were limited in having to take two bulls of each breed and have them carefully identified by the marking. We are making Hereford $\times$ Angus and Hereford $\times$ Charollais crosses:

Herd 1	Herd 2
Hereford cows	Angus cows
Hereford bull	Hereford bull
Angus bull	Angus bull

We will get straight breeds from each, and crossbreds. The second year the bulls will be switched. We will take five calves from each breed and crosses, and take them back to Davis and get data through carcasses.

We have the same experiment comparing Hereford and Charbray (75 percent or better Charollais). If this works well we may expand it to the Shorthorn breed.

Dr. Stonaker:

On your feeding trials there is considerable difference in daily gain, but on TDN they are about the same. What is the use of having the daily gain if we are not getting efficiency?

Dr. Rollins:

In analyzing this we have to take into consideration the size of the animal and what is happening during the test. Each month we get a condition evaluation. It is very interesting how this bull reaches points thirty days ahead of the other. In some of those things it makes it interesting. We get weight gains each 30 days.

Our best herd sire when on test with this set-up was evaluated for slaughter condition as Good and the other animals as Commercial, and when he came off the test he was Prime and the rest were just getting in Choice.

California - Dr. Gregory:

Our program is primarily comparative biology and genetics with normal and mutant stocks. We have developed with the anatomists eight different criteria for recognizing achondroplastic dwarfs.

We have 700 skeletons with complete case histories. We have, of course, to get control material, so we have obtained slaughterhouse material. We know the size, the approximate age, and we have some other information on them. This is not the best source of information for "normal" populations, but from this information we can make rather complete analyses in the future on different types of mutant stocks. We are going to be able to check on mortality losses in calves. We are conducting cooperative testing for other stations, some more or less formalized--New Mexico, Arizona, and Oregon--and some other cooperation that is less formalized.

One of the indexes we are interested in is Dr. Julian's method of measuring degree of hydrocephaly. We would like to get additional field data on hydrocephalous calves. If anyone has any type of abnormal calves that die, our laboratory will do the diagnostic work. All we want is a complete case history. We will give as complete a report as possible. It all cannot be reported because we have to work out standards for measuring. We have cooperated with several stations in this way--Montana and Utah.

Colorado - Dr. Stonaker:

One interesting thing has come out at our station. The correlations between scrambled efficiency and daily gains have to be higher than the actual correlations. Correlations are higher on scrambled feed than on individual feed. The low-gaining animal has an opportunity by random to take low feed per day.

We are happy that the work with California has continued. We are entering our last breeding season at Fort Lewis this year using our last series of bulls.

We sent bulls to Oklahoma again this year to be used in the Coddling herd and then returning for use on our own herd at Fort Lewis. There will be some cross-testing between Colorado, Oklahoma, and Mississippi.

The general results at Mississippi indicate at this time some differences in the progeny groups. There was some correlation between the performance of these bulls at Colorado and the way they were doing at Mississippi which I think may indicate on a very preliminary basis perhaps with these Hereford cattle we may not have to worry too much about location interactions. They are stacking up the same way thus far at different stations.

The control group of Herefords at Durango did not seem to do so well as the line cross, although somewhat better than inbreds, although on efficiency they were not too bad.

(Dr. Stonaker then showed a movie of an abnormality he ran into in a line of cattle, and he had also found the same thing in an outlying herd.)

Hawaii - Dr. Cobb:

Unfortunately, I do not have as much to report as I had planned to have this year, but I have had some basic things to do.

We are in the process of getting a new research center at the University of Hawaii, including a meats laboratory. We are getting a new computing center. During the year under another project on foods and nutrition I was able to start work on carcass evaluation and meat evaluation.

Getting back to the project, we are now cooperating with one concern which owns two ranches which have been in the program since its inception. They have a high regard for research and are pushing it to the limit, and we are fortunate in being able to take advantage of their interest.

Starting this year we hope to leave the bulls as bulls to weaning, then take a sample of six offspring from each sire group and use those for carcass determinations in feed-lot tests.

We have started routinely semen-testing the bulls used in the project and we may be able to do some further work on that. I am primarily interested in testing the bulls for fertility on the immediate work. One bull showed up with bad semen according to the veterinarian who did the testing. Later he was retested and showed up with acceptable semen. He was put with cull heifers, so we will have a record of his acceptability.

We have five years' data under analysis. I will use IBM facilities, so I have done some extra work on learning the machine and the techniques involved.

I have a few adjustment factors. Some agreed fairly well, but some differed.

Least Squares Estimates of the Effects of Sex, Age of Calf, and Age of Dam on Weanling Characteristics of Beef Cattle^{1/}

	Weaning Weight (Lbs.)	Daily Gain from Birth to Weaning (Lbs.)	Weaning Conformation Score ^{2/}
Bulls - heifers	41.4	0.179	-0.44
Regression on age at weaning	1.266	-0.0021	0.004
Age of dam (adjusted means)			
3-year-olds	470	1.73	4.1
4-year-olds	474	1.75	4.3
5-year-olds	480	1.77	4.2
6-year-olds	487	1.79	4.3
7-year-olds	492	1.82	4.3
8-year-olds	477	1.74	4.2
9-year-olds	479	1.72	4.0
10-year-olds	486	1.73	4.1

1/ Data on 704 calves from 2 ranches for a period of 4 years (1955-58).

2/ Range of possible scores from 9 - 1.

These will be carried on through and some further checking done, then adjustments will be made on data gathered.

There has been increased interest in the project by the cattlemen. Two large ranches are interested in setting up their own programs in the near future, one with roughly 3,000 head of cattle, although they will not use the entire herd but will set up a selected herd on which they will try to do a good job, and a more limited job on the remaining herd.

We hope to concentrate a good deal of our effort on the carcass phase of the problem. We will use the herd to produce the cattle, then purchase the steers, feed them out, and gather carcass information on these animals.

Next year, work will be initiated on new phases of the study, and we will finish up the analysis and publishing of the data already collected.

Dr. Stonaker:

Is anything further being done on the progress of selection under grass conditions, or is that basic to all of your work?

Dr. Cobb:

That has not changed. That is basic to all of this.

I did some correlations on unadjusted data within-year and for only one ranch, and I did the phases separately so there was a phenomenal agreement on all except those phases involving conformation score.

Correlations Between Various Performance Characteristics of Beef Cattle^{1/}

	Sex ^{2/}	Daily Gain from Birth to Weaning	Weaning Conformation Score	12-Month Weight	Daily Gain from Birth to Yearling	Yearling Conformation Score	20-Month Weight	Daily Gain from Birth to 20 Mos.	20-Month Conformation Score	Daily Gain from Weaning to 20 Mos.
Weaning weight	S ₁ S ₂	.83 ^{3/} .80	.70 .72	.75 .73	.67 .60	.37 .15	.75 .74	.51 .50	.61 .32	-.13 -.32
Daily gain from birth to weaning	S ₁ S ₂		.73 .70	.58 .40	.84 .73	.42 .07	.70 .60	.61 .52	.58 .27	-.06 -.33
Weaning conformation score	S ₁ S ₂			.40 .39	.52 .51	.43 .23	.61 .47	.58 .23	.60 .41	+.00 -.43
12-month weight	S ₁ S ₂				.79 .66	.52 .49	.66 .67	.50 .57	.47 .37	.19 .11
Daily gain from birth to yearling	S ₁ S ₂					.57 .33	.69 .63	.70 .58	.52 .38	.20 -.00
Yearling conformation score	S ₁ S ₂						.47 .25	.59 .38	.47 .53	.39 .30
20-month weight	S ₁ S ₂							.91 .88	.77 .65	.51 .35
Daily gain from birth to 20 mos.	S ₁ S ₂								.70 .61	.74 .60
20-month conformation score	S ₁ S ₂									.35 .44

^{1/} Data were not adjusted for age of calf or age of dam. Correlations were calculated within sire and year.

^{2/} S₁ = Bulls
S₂ = Heifers

^{3/} All correlations $\geq .25$ are significant at the 5 percent probability level and those correlations $\geq .33$ are significant at the 1 percent probability level.

In general, the ones with score are low. Those involving gains at different periods are fairly high.

Idaho - Dr. Christian:

We are particularly interested in the study of age at puberty in the beef heifer. We now have three years' data. We have only approximately 30 heifers each year at our station, and for the total of three years we have slightly over 100 heifers in which we have checked age at puberty. The averages for the three breeds for the three years are approximately the same:

Hereford	364 days
Shorthorn	366 days
Angus	369 days

Most of the heifers ovulated at first estrus. Three did not ovulate. Three had ovarian cysts; in the others we didn't find anything.

Eighteen ovulated at least once, six of them ovulated twice, and of these, two ovulated three times prior to the first detectable heat.

Through a study of post partum phenomena we hope to find indications of the future reproductive pattern. In two years' work with 30 and 35 cows, respectively, the number of days from post partum to involution of the uterus was 41 days and 43 days. Approximately six weeks for the uterus to return to normal position, tone, and size. The number of days to first detected ovulation was 44 days in each year. I have made some correlations:

Study on Post Partum Reproductive Phenomena. (All Hereford cows palpated weekly following parturition).

		1957	1958
Number of cows		38	35
Days to involution		41.3	42.8
Days to ovulation		44.2	43.9
Correlations		1957	
	Days to Involution	Days to Ovulation	Date Calved
Age	.122	.152	.428
Days to involution		.390	-.342
Days to ovulation			-.353
^b Date calved and age = 2.81 days/year of age.			
		1958	
	Days to Involution	Days to Ovulation	Date Calved
Age	.600	-.105	.030
Days to involution		.480	-.468
Days to ovulation			-.409
Age of 1st half to calve = 6.4 years			
Age of 2nd half to calve = 7.1 years			
Repeatability			
Days to involution	-.103		
Days to ovulation	.149		
Calving date	-.117		
^r Days to involution 1957 and calving date 1958 = -.068			
^r Days to ovulation 1957 and calving date 1958 = -.039			
Path Coefficient Diagram		1957	1958
Age		² $a_2 =$	.05
Date calved		² $b_2 =$	.14
Days to ovulation		² $c_2 =$	.05
	Days to involution		.43 .10 .18

These two traits apparently are very low in repeatability. The correlation between days to involution one year and the next year was approximately 0.1; days to ovulation 0.15; calving date 0.1. Since the two traits apparently are low in repeatability, they apparently are not very high in heritability.

The correlation between number of days between involution one year and calving date the next year is -0.06; number of days to ovulation and calving date next year, -0.04. So, nothing is very predictive on when the cow will calve.

I hope to have a revision of the project very shortly. I hope to expand the work this year to include some carcass data.

I am summarizing some of our production work from the Idaho studies.

Dr. Keith Gregory:

What kind of nutritional regimen were these cows on? The days to ovulation seemed to be less here than from some of the other reports.

Dr. Christian:

Particularly dairy cattle. The cows which are nursing calves come into heat later than the cows not nursing calves. These cows are on good grass, no grain. Calving starts in early March. These early heifers are fed roughage--primarily alfalfa hay--but practically no grain. They make about one pound or a little better--not repeatedly, but in gaining condition.

Montana - Professor Willson:

We have four herds, two Hereford and two Angus, in which the bulls are selected from our ROP Herd, selected by the usual performance-testing procedures. In the other herd, we are cooperating with the Montana Hereford and Angus associations, which pick out bulls that go into the herds.

Until last year, they were selecting bulls to head up the "show-type" herd that were running 250 to 300 pounds lighter than the bulls in our ROP herds. Both Angus and Hereford. However, a year ago the committee picked out bulls that were every bit as big as our ROP bulls, and it was amazing to hear their discussion of why they did that. The Angus association looked over the various bulls. They discarded the small bulls as being too small, too compact, too short-legged. "Ninety-eight percent of our bulls that we sell go to the commercial trade and you can't sell these small bulls to commercial men." This year, they chose a 12-year-old bull. They say the bulls are not selected because they are particularly "showy" animals, but because their progeny have been particularly well accepted in shows.

We were very gratified to see that the Hereford and Angus associations are both recognizing the merits of performance testing, and even though they don't call it that are using these methods in selecting bulls for these lines.

This year, there was a difference in the two herds--Angus and Hereford. The Angus group took off on the feed quicker. They didn't show the shrink in the warm-up period but seemed to take off faster. I don't know whether they will continue. In the past, we said our Angus calves were heavier at weaning than the Hereford calves, but in our records for the past year we cannot see that. Either the Angus are going down, or the Herefords are coming up. They are equalizing and are much the same now.

So far this summer in indexing there has not been too much difference in average daily gain in feed lot for 140-day test. The weights get increasingly wider apart after we get to 12 to 20 months of age. ROP herds pull away quite drastically at that time. In body score, there is a little more of what we call "acceptable" type as we now know it. Of course, we don't know what is "acceptable" type, but on present standards we do find they will run from two to four percent higher on body score than our ROP animals. That is not so consistent in our Angus herd. Our ROP Angus have scored higher than our outbred herd.

We have acquired a ranch 33 miles west of Bozeman which is primarily sheep and livestock country. We brought cross-line heifers from the Havre station and bought some heifers of the same age a year ago. The difference in weaning weight of these calves was 33 pounds. But there were sire differences involved. This year, all were bred together and we find that the difference is 16 pounds adjusted weaning weight in favor of the cross-line heifers.

At Havre, they inaugurated last year a trial where they picked up some groups of steers that were within 150 miles of the station, and about the same age as the station herds. They were gate-cut at the station, stratifying the late and early calves off. They were brought in with the idea of testing with our cross-line production at Havre.

We have three separate tests at Havre in which they are taking the two top bulls and mating them to Line 1 cows. In this recurrent selection program, we also take into consideration the carcass data in determining which bull goes back into the lines. If it appears that the younger bull is superior to the older bull, then the younger bull will replace the older bull in heading up the line. These closed lines proved very interesting.

Group II (page 2, table 1) steers were from a ranch which has been using bulls from the Bozeman station, ROP bulls, and has been using them for five years. So, they show some effect of having been selected for gaining ability. Group II steers showed an advantage of 9 percent over the rancher groups.

The difference between ranch groups and the average of our cross-lines was 13 percent without Group II. The difference of the cross-line over Miles City Line 1 is a 5.3 advantage over Miles City Line 1.

Lot effects were eliminated. Feed efficiency could not be computed.

Mr. Windecker (Superintendent, North Montana Branch Station):

We feel fortunate at Havre to get the cooperation of these ranchers. We were particularly interested in what we were going to get out of the information from these cattle. We did not expect and did not get any big differences, but there are some things that are interesting.

We picked from herds of cattle which we knew the history of pretty well. We are interested in the possibility of new lines where we know the history of the way these cattle have been handled.

In gathering carcass data we took length of body, rib eye measurements, differences in rib eye area.

	<u>Length of Body (Cms.)</u>	<u>Rancher</u>	<u>Station</u>
Group I	11.49		
II	11.67		
III	11.41		
IV	11.27		
V	11.13		
VI	11.72		
VII	11.35		

Miles City Line 1	11.76
Havre Line I	12.07
I	11.64
II	11.48
II	12.02
III	11.60
III	11.68

Average rib eye measurements	11.23	11.37
Separated rib eye - ranges of averages	2.31	2.94

	<u>Fat Thickness (Mm.)</u>
Group I	15.4
II	16.7
III	15.7
IV	16.9
V	14.7
VI	16.0
VII	16.7
Miles City Line 1	14.3
Havre Line I	13.8
I	17.8
II	13.0
II	19.0
III	15.2
III	16.3

Dr. Burris:

You took the steers you had. How were the others selected?

Mr. Windecker:

They were randomly gate cut.

Dr. Stonaker:

The Montana people should be commended for this kind of approach. There is need for this kind of information.

Nevada - Dr. Cassard:

The beef cattle work has been going four years and no appreciable amount of analysis of data has been made.

At Elko we have two lines, at Reno three. One line is selected on rate of gain, one on economy of gain. At Reno one conformation line is carried.

We individually feed-lot test postweaning for 140 days all offspring from all lines. One hundred ten animals in total were tested--Reno 34 bulls and 34 heifers, Elko 17 bulls and 25 heifers. Selection is made in each line for the single criteria for that line on basis of postweaning data.

In each line we have added all heifers above average each year. About fifty percent are added. We started with a small number of cattle, then we added, so we have been coming up to strength.

Calf crop percentages are somewhat lower than we should get, particularly in the Reno rate-of-gain line because we have kept some cows we should have culled under different conditions.

We now have enough data accumulated so we can run out a set of adjustment factors this year, and hope to do that soon.

The only important change in the project this year has been improvement in facilities. We have constructed an individual feeding plant at each of the stations which should improve accuracy of taking feed consumption data.

We have an individual pen set-up--43 individual pens at Elko and another 43 going in this summer. A total capacity of 96 animals. One hundred sixty individual pens at Reno are just being completed. Our facilities are improved for testing.

The laboratory animal work was newly taken up under W-1 last year, although it has been going on for several years. It was started by using four inbred

line stocks of rats, making all possible double crosses to get a homogeneous population. Four lines from this population are carried on two selection procedures and two nutritional levels.

Nutritional: Standard laboratory ration

Standard laboratory ration with 35 percent ground alfalfa added (stress ration for rats)

Selection: Selected for 70-day weight

Selected on random mating basis

This year the sixth selected generation has been produced and we are now producing the seventh.

New Mexico - Dr. Holland:

Dr. Blackwell has a large volume of analyses from the station with him. He did these analyses in the Denver office working with the people in Denver, and since his analysis was almost completed at the time he left to go to Dubois he knew what it contained better than I. Therefore, Professor Knox and Dr. Blackwell thought it would be well for him to go ahead and complete the publications.

Dr. Blackwell submitted an article on the hydrocephalous condition in cattle to the Journal of Heredity, and it will be published soon.

We have increased the meats research at the station. D. W. Zinn has been added to our staff and last year gathered additional data on the animals and is studying creatinine and antipyrine in relation to blood characteristics.

Professor Knox actually takes the data on most of the cattle, decides which matings to make, and pretty much the selections. Because of this, there has been a continuity in spite of turn-over of personnel.

Oregon - Dr. Bogart:

One of the things we are doing that has already been reported but to which I want to call your attention is that we are sending bulls from our three lines of Herefords here at Central Station up to the Union Station. They are using these three from our station and one from their station, twenty-five cows to a bull, in their grade cows. The plan calls for keeping three bulls from each sire that will be individually tested, feed the steers in the lots, getting rates of gain, and carcass evaluations on these steers. Hold the heifers for use as replacements and get criteria on cow productivity from sire groups at second calf. They breed as yearlings to calve as twos, so get lower calf production the first year.

The first group is coming off test on this program right now. I don't have any data yet, and data on weaning weights of calves are not meaningful without follow-up data.

It is going to tell us something about the comparative values of our lines here. This will be continued for a minimum of four years. We wish we could get two bulls from each line but we don't have enough cows to make it meaningful.

We are also sending bulls from two lines to Astoria, where they are doing the same sort of thing.

The Squaw Butte station has been interested in whether or not we can get information on production testing on what you would call the wintering stage. They have quite a number of years of work using heifers in which heifers were individually fed using roughage and concentrate in different ratios and checking rate of gain.

The heifers have been feed tested individually through the first winter, followed by summer on the range, brought back and some put on a high level of feeding for the second winter, and now bringing the offspring in and putting them on feed test. We will have an evaluation of how these animals did one period with another period and how the offspring of each of these animals do. Dr. Hubbert has some of this material summarized.

Dr. Hubbert (Squaw Butte-Harney Station):

Our primary interest was from the standpoint of the producer in being able to test his heifers and being able to use this rate of gain and efficiency data as a replacement tool in selecting heifers.

This is a different problem from testing bulls, where one would be selecting only ten percent or some such figure to stay in the breeding herd. So, if they were fattened during the wintering period and ability to gain rapidly measured, some conclusions might be drawn.

One of the first things we were interested in was a performance measure of relationship between winter gain and subsequent summer gain. How much depression do we get, and is that linear or not?

We have some 200 animals. We fed a full-feed of chopped mature hay and some supplement. The high plane received 1:1 hay and concentrate.

When our calves are fed to gain from 0.4 to 1.0 pound per day during the wintering period we get no depression in summer gain over this range. The animals that gain from 0.4 to 1.0 pound per day averaged 0.6 pound per day on grass. If they went up 0.2 to 0.4 pound per day we began to get a drop-off in the summer performance. However, with the numbers of animals we used this is not significant but the mean has dropped to 0.5. After we

go over 1.4 pounds per day we get quite a steep decline in summer performance. This is not a linear relationship. We found a significant negative correlation between winter gain and summer gain. We do feel we can go up to 1.4 pounds per day during the wintering period without appreciably depressing their performance on grass. This whole picture was first one way then the other depending on the range, the animals, or all. In this case our animals were able to gain approximately 1.6 pounds per day on grass where they gained 1.4 pounds in winter.

Perhaps this is not of as much interest to animal breeders as it is to nutritionists, but it has an important bearing on using a test of this type on commercial cattle production.

With respect to efficiency of feed conversion, we have found a negative correlation between winter gain and summer gain, but we realize this is not a true story of genetic influence. However, when we have taken the animals tested as weaners, put them on grass, and then brought them back on test for the second year, we get some picture of what we get with these two test rations. The animals on the low plane of nutrition, average daily gain during the first winter period was 0.9 pound per day and on high, 1.77 pounds. Those on the low plane of nutrition, there was no correlation between gains the first and second winter. On the high plane of nutrition there was 0.48 correlation.

Perhaps we still do not have a test which will be precise in testing genetic influence. Perhaps we are not doing a very good job of selecting animals that have the best genetic ability to gain on the lowest ration. We have this close negative correlation between winter and summer gain.

Maintenance requirements in terms of TDN for all animals--studied from the standpoint of TDN above maintenance requirements--we have no direct measure of maintenance, and this would be very interesting if it could be done. Are animals more efficient because they are maintaining themselves, or are converting energy above maintenance for gain? In calculating TDN for maintenance on basis of body weight (Winchester) positive correlations between gain on summer range, if we consider efficiency, on a low plane of nutrition had a positive correlation of 0.21, and on a high plane 0.27.

The pay-off on the study will come as we complete the work with the progeny of the progeny-tested dams. We should be able to determine whether or not we were actually picking out the heifers that had the genetic ability to gain.

Preliminary analyses relating efficiency of animals to gain:

Efficiency was very much higher where the gain was higher, and efficiency went down as the gains were lower.

When they were held down to a low gain or did not make a good gain, it took a lot of feed to make a unit of gain.

When they did well because of more feed or because of a better animal, it did not take so much feed. But after a certain point it comes back up.

Dr. Bogart:

We made other analyses of effect of inbreeding on production traits of beef cattle. We did not separate inbreeding of dam and there is some confounding, but inbreeding of calf depresses suckling gains of calf, but it did not appear we got any effect on test. All animals were inbred, some very highly.

Growth patterns have been studied in our cattle and we are hoping we can describe growth and feed efficiency because for the past six years on 350 animals we have weekly weights from birth and weekly feed efficiency from 500 to 800 pounds, so we have a possibility of getting a description of normal animals. There are four lines so we could assume there was an average amount of abnormalities so we hope to get a description of this.

Mr. de Baca has made a description of estimates of repeatability of productivity.

Birth weight	.15
Weaning weight	.33
Yearling weight	.31
Long-yearling weight	.16
Suckling gain	.34
Yearling gain	.23
Long-yearling gain	.16

There were some indications in the steer analysis of permanent environmental influences due to the age of the granddam.

A cow out of a two-year-old dam will produce less effectively than a cow out of an older cow. This was not true in the heifer data but in the steer data it seemed to be there.

Animals which in one period endure a restriction in growth tend to compensate for these restrictions in the next period. They are met through what you might call a reverse compensation pendulum. If it swings a long way it swings a long way back but eventually stops.

U. S. Range Livestock Experiment Station - Dr. Woodward:

We have two projects, the first the development and testing of methods of measuring performance. The emphasis has shifted to methods of improving carcass. We recently completed a summary of carcass analysis, the work covering 210 steers of which samples from 56 steers had been sent to Beltsville for physical separation and tenderness tests consisting of shear test and panel taste test.

In the other project, development of superior lines of beef cattle, we are interested in setting up top-cross tests that will give us an appraisal of the lines we have produced.

We have set up a test with Iowa State which should give us some information. We have top-cross tests under way in four states--Arizona, California, South Dakota, and Montana.

Our inbred lines vary a lot in size. One consists of 180 cows. Then from there they run down to as few as 30 cows. Miles City has nine inbred lines.

Sixty cows were used in the Montana Hereford Association test. The group sired by a Line 1 bull bred to unrelated grade cows random-selected associated by age groups gained 0.3 pound per day more than the group sired by the Montana Association bull. The other inbred Miles City bull sired calves gaining 0.15 higher than the calves of the Montana Association bull similarly selected. These are not final figures--not the completion of the test.

Crossbreeding work has progressed to feeding out the first group of Charollais × Hereford steers and straight Charollais, and calculating these results against the Montana Hereford Association group and the Line 1 bull in the top-cross group. We are finding that the Charollais steers (the herd is probably 15/16 Charollais - 1/16 Hereford) are about intermediate among the Hereford lines. Weaning weights slightly above the Hereford, even above the best Hereford on 180-day corrected basis.

The crossbreds are extremely variable. One group was probably the fastest-gaining group ever fed at the station. In the past 34 days they have gained over 300 pounds. The other group of Charollais-cross steers are intermediate. They are being surpassed by some Hereford steers but are about comparable to our Charollais.

Dr. Clark:

Would Dr. Damon care to give a summary of his experiences with Charollais?

Dr. Damon:

The Charollais at Miles City looked to me like they showed a lot of Brahman in them. I think you have a bit more than Hereford in them.

We lost some heifers by breeding to Charollais, but on the whole the birth weights were only five or six pounds heavier than other calves. Carcasses have been very disappointing when Charollais have been bred to Brahman or Brangus cattle. On English breeds they showed up with good carcasses. With Brahman and Brangus they don't pick up finish. We didn't find much in the way of marbling from visual appraisal or from ether extract. We fed our steers out on pasture with grain supplement. They didn't have the advantage of straight concentrate feeding, but they didn't show much marbling. The Charollais has shown the largest rib eye area of any of the crosses, size constant.

Utah - Dr. Bennett:

You will recall that we are working on the development of two lines of Herefords and one line of Shorthorns. One line of Herefords is at Panguitch, the others at Logan. Some changes can be made in heifer selection in the future. The line at Panguitch is up to strength.

Mild inbreeding accompanied by selection is the system. The inbreeding level is not yet high. We would average somewhere around 14 to 16 percent at the present time.

One of the most striking things is the difference in weaning weight between Shorthorns and Herefords. The Shorthorns were higher than the Herefords by 40 pounds. As to average weight of cows in the herds, the Herefords are as heavy as the Shorthorns but are carrying more fat.

We have been trying to determine body composition with tritium and anti-pyrine.

Specific gravity readings taken on a carcass must be taken very quickly. The time must be standardized because it does not go to a weight and keep constant.

We are trying to find a direct quantitative chemical method by which we can make a direct measurement of glutamic acid with considerable accuracy.

We started some carcass investigations and plan to continue and enlarge them and study these lines for the type of carcass they produce. We did some work with sheep--got estimates in type and slaughtered them at a condition-constant time and made measurements on the various carcass parts. The point that was interesting is that apparently we can change the amount and size of the rib eye without changing the amount of meat in the longissimus dorsi. If it goes along in beef cattle we will have to do some work on that.

We did not do much work with paper chromatography for lack of a technician. You may be aware of many new techniques developing in the field of

chromatography, many new machines. We did test out the centrifugal machine. With it in 20 minutes you can get a reading that would normally take 16 hours.

We did some testing of bulls from private herds at a central testing station on the campus. This was repeated this year. The program was very successful in achieving the objective--create more interest in private breeders in performance testing and show that there are animals of the same type differing in performance ability.

Many producers will start on performance testing programs for this year, and some producers who objected to the program are quite congenial when it is mentioned to them now.

Washington - Dr. O'Mary:

We have obtained a few head of albino-carrier cattle. A fellow brought up an albino dwarf when we began our albino study. We got complete records on it as it was on an FFA project. Six heifers had been bred to their half-brother or their full brother, and three albinos were produced. We obtained the herd--the sire that was producing the albinos, his sire, his dam, and another old cow that was half-sister to the dam, and then the daughters. We bought them up although they were bred to another bull at the time. This year was the first time we had a chance to get matings and of the eight calves produced this time there were three albino calves. No dwarfs were produced, although the bull has produced dwarfs in the past.

This year we are mating those that produced the albinos back to the grand-sire. I am pretty sure it has come through the grandsire, but we want to check that out.

We are especially fortunate if this is a recessive we are way over our proportion on the thing.

The albinos are affected by sunlight. If they are out with other animals they stand in the shade. Last year all of the albinos died. The one we got as the albino dwarf died. It had quite a lot of lesions.

The animals we got are not especially light colored. There is one line-back in the group.

Wyoming - Dr. Stratton:

This term "carcass merit" we talk about, but I cannot explain it. In our work we have taken the relationships for three criteria--length of body, rib eye, and depth of round (not circumference of round. The distance measured from a constant ring that we place over the round and measure to the line assuming if the round shows no bulge it has greater thickness). These three criteria seem to be worthwhile in establishing differences in true yield of carcass.

Panel Discussion

Beef Cattle Breeding Research and Its Application
to Improvement under Ranch Conditions

Panel Members:

Industry: Mr. Larry Williams, Rancher
Canyon City, Oregon

Extension Service: Dr. J. C. Miller, Head
Department of Dairy and Animal Husbandry
Oregon State College

Research: Dr. E. J. Warwick, Chief
Beef Cattle Research Branch
Agricultural Research Service
U. S. Department of Agriculture

Dr. Bogart:

We have been extremely fortunate in Oregon in having the fine relationships we have with our producers. One reason is that we have some of the highest-type people in the production end. There are a good number whose training and ability are such that sometimes they put the rest of us in a spot because we have trouble keeping up with them. These people bear down on us sometimes for information that we think we have but we don't want to release it yet because we aren't sure.

One of these ranchers has been keeping good records and doing good production testing for quite a number of years. He has good cattle. I thought it would be wise to start the panel off by having the rancher tell us what he needs from extension, then have the man representing extension tell how information gets from the researcher to the rancher, then follow with the research man on this panel, after which there are no holds barred.

We have Mr. Larry Williams, who operates both commercial and purebred herds in Oregon. He has good cattle, keeps good records, and it is a pleasure to me to introduce Mr. Williams.

Mr. Williams:

We operate a 400-head cattle operation. It is a family affair, being run some twenty years, with four of us involved.

We run strictly under ranch conditions. We started out with a strictly commercial outfit. We couldn't stand to take steers to market and not know how we produced some good and some bad from the same environmental conditions. So that is how we came to keep records, for we wanted to know

the mother of the good steer so we could keep her. We in the producer field appreciate the information you have given us. It does work. When we cull those cows we find that those that produce good steers produce all the time. It must be aggravating to find us in the field doing such a poor job. We are not doing a good job of putting into practice the research facts you teach us. However, our ranch is typical of many producers in Oregon.

We keep a minimum of records on our commercial herds, but we find we need all of those records. We break our records down on a page, the upper portion assigned to the cow as she goes into the herd, and the bottom half has each calf and records concerning the calf throughout its lifetime.

We are breeding close, but not as close as the College. We are weighing cattle as we are taught, at weaning time. We started out weighing them when they were born, but discontinued it. We didn't think we were finding out any information that was necessary to us. We are weighing at weaning time, on test, off test, and until they are two years old. The problem at the ranch has been we have been selling too many cattle at weaning to get full information. As long as the cattle are on the ranch we keep them weighed and keep testing. We take rate of gain or size for age at a given time and compare those cattle in deciled order. We grade what we call in ten deciles, which is most helpful to us.

We gather quite a large mass of scores on a cow by the time she is carried for 10 or 12 years. We record the decile in red. We have a decile at weaning and off test and size for age. Each decile on the sheet is on in red for if we have it in red we can check the page for the red scores and know how that cow stands in the herd.

We cull our cows from the sheet and know what the grandson or granddaughter has done. If there have been some bad animals develop in the grand-offspring it shows up. Or if there have been some good, it shows there. We feel we can take our system and what you teach us and put together a herd. We are improving. We have our cattle production improving. And we are doing it not just with paper. We use the extension service, we do what the college people teach, and we can take our paper and see pretty much what a cross is going to produce before it comes. Not exactly, but we know which animals will be up, and we can cull at the bottom.

In our commercial herd we don't go that far. We are generally recording the top and the bottom, and I think that is a minimum. We identify all of our cows. We identify all of the commercial calves. We know the sire because of separate breeding pastures. We have a record on the cow, we record information on the calf at weaning time. That is the minimum record I feel it is possible for a person to make to improve a commercial herd.

I see in some neighbors' herds where they could so quickly improve by selecting the top and culling the bottom.

There are some facts we are in need of that perhaps we can present to you people.

I have asked a couple of people on the campus whether or not we are keeping records that we must stay within. I was thinking that we should not compare any oftener than necessary other cattle's production or rate of gain unless we have somewhat similar environmental conditions. You know, researchwise, that we cannot compare in our present thinking one animal's rate of gain against another's when there is different environmental background. Is there any way of breaking that down and comparing animals across environmental backgrounds? If it is an impossibility, it is a stupid thought. But it is dangerous for me to say that under my conditions, say, an animal gains so much a day, and think that this is any measure of value as against Dr. Bogart's under their conditions, or someone in Arizona. Yet the world is competitive and we must compare.

The other thing is, we talk about "rate of gain", we love "performance." What we need is for you not only to tell us how to produce rate of gain and efficiency but also how to evaluate and how to produce the carcass that we must have to sell our wares on tomorrow's market.

The consumer wants certain things. We talk about carcass grade, and actually that is made up of three things that are most costly, the most desirable to the consumer, and yet the most hard to determine.

Fat has no place in consumer preference. Conformation can be confused with fat. If I have a good animal I cannot sell him for too much money unless I put the fat on him.

Watch what you tell us to do next so it will produce in the animal what the consumer wants to buy. We must then produce it as economically as possible.

I know when you get to the end you do a good job of telling us how. But in the industry we want to be sure that what you tell us to do results in what the consumer wants to buy. You people know more than we do. You can put it in the field. All I can do is represent the industry and say that the industry is behind you and urging you to keep on. We try to put your work into effect. We hope you will reach out and get the information as well as you have in the past.

Dr. Bogart:

Dr. Miller is going to represent the Extension Service--getting the material to the rancher. Dr. Miller.

Dr. Miller:

In the improvement of beef cattle, as we consider the use of performance as a guide to selection, it might be well to review some of the steps in the evolution of the idea and its application. Historically, there is nothing new about performance testing. The Arabs used it in the development of Arabian horses centuries ago. Its application to beef cattle, however, is relatively new. Probably the earliest work on beef cattle was done at the Miles City Station under the direction of Dr. R. T. Clark and his associates. In that early work, one of the most significant things observed was the correlation of gains with length of body. Animals with a little more stretch or length were the faster gainers. Later work in bull testing at Miles City and the Texas Station demonstrated three rather important facts that focused attention on this area, namely:

1. Wide variations exist in both rate and economy of gain in the same breed and in the same herd under the same environment.
2. It was demonstrated that the ability to gain was highly heritable.
3. Most surprising was the lack of correlation between rate of gain and accepted standards of body conformation.

In some of the early work, it was quite common to find the faster-gaining bulls or steers were what we considered to be the wrong type. Purebred breeders were alarmed. We had resistance from feeders. They didn't want that kind in the feed lot for they would not finish out early. There was packer resistance because the yield of preferred cuts was believed to be low in that type of cattle.

As to factors which have contributed to delayed acceptance, we in research are partly to blame for the reluctance of cattlemen to accept this new tool. We went all out to proclaim its importance, even to the extent of total disregard for type and conformation. Some of us were willing to ignore completely the results of generations of selection for a thicker, meatier, earlier maturing, smoother kind of beast. Breeders, both commercial and purebred, were reluctant to accept this idea.

Crossbreeding: At about the same time we were making so much noise about rate and economy of gain, crossbreeding came into prominence, especially in the Gulf Coast country. We heard all sorts of fantastic stories about the advantages of crossbreeding. It made no difference, it seemed, what you crossed just so you were crossing something. Many people rebelled against crossbreeding because it was associated with the rate of gain emphasis, at the expense of conformation and quality.

Cattle Prices: When prices are good, people are not too concerned about adopting new tools. From 1933 to 1952 all one had to do to make money with beef cattle was to own them for a short period of time. Because many of

the crossbred cattle differed from conventional type, packers discriminated against them. There still is unjustified packer discrimination against certain types of cattle. When the producer is penalized at the market place, it need happen only once and he backs off from any program which changes his type of cattle. Regardless of how good a tool might be, if it does not pay off at the market place, it is not going to be used by the man in industry.

All of these factors tended to confuse Extension Specialists and very little was done by them in promoting the use of performance as a guide to selection. They could not afford to push a program until they had more solid footing and more information on how to proceed.

Prices: We can also point to trends toward acceptance of performance as a guide to selection. Beginning in 1952, within a six-month period cattle prices dropped by as much as 30 to 50 percent. When a situation of that kind exists, cattlemen seek new ideas and new cost-cutting tools. They were desperate to find ways of producing beef more cheaply. Any idea or any technique which would permit more efficiency in their operation was a welcome tool. Undoubtedly, that was an important factor in the minds of many people who gave attention to performance as a guide in the selection of their breeding animals.

Bull Sales: By 1953, a number of states were holding sales of performance-tested bulls and though they got off to a slow start, each succeeding year saw greater acceptance in terms of prices paid for these tested bulls. With few exceptions, buyers were paying the most money for the higher-gaining bulls. It was also evident they were not willing to pay for gain alone because the off-type kind were not selling well regardless of rate of gain. Top prices were being paid for top gainers with acceptable type and conformation.

Production Costs: Costs of producing beef have continued to increase year after year since the end of World War II. Labor, machinery, fencing, feed and all fixed costs add up to making the cost of raising beef a little higher year after year. This, too, has been a factor in causing cattlemen to look for ways and means of increasing the efficiency of their total operation.

Dwarfism: Cattlemen observed that faster-gaining cattle are usually larger framed and many of them thought they were getting away from dwarfism by using larger cattle. While we know this is not necessarily true, it undoubtedly has been a factor in helping many cattlemen adjust their sights in their evaluation of breeding animals.

Carcass Studies: Sufficient evidence has been uncovered in recent years to throw new light on live animal-carcass value relationships. Many of our old and cherished ideas have had to be abandoned. We have learned that cattle which don't quite meet our ideas of type and conformation on foot yield just

as well and just as much of the preferred cuts as cattle whose conformation is more desirable. Differences in yield of preferred cuts are not as great as they appear to be on the live animal. Carcass studies have brought out the fact that we have greatly over-emphasized shortness of leg and compactness of body.

Resistance to Fat: The widespread resistance to fat by the American people has contributed to the need for a critical look at our breeding programs and the type of animals we are producing. We are told this trend of consumer resistance to fat will continue and that it will continue to influence our thinking as to the kind of animals we produce. We believe it is necessary to select for and produce that red meat steer everyone is talking about, but no one knows just what he looks like on foot.

Demand for Reputation Cattle: In recent years we have seen feed-lot operators willing to pay premium prices for calves out of herds having good performance records. Where such cattle are available, feeders go back for them year after year, and where they can they contract for them in advance at a substantial premium above going prices for feeder cattle.

Beef Cattle Improvement Associations: Some 20-odd states now have beef cattle improvement associations which are affiliated with Performance Registry International. These associations have been effective in focusing attention on this whole area of emphasis. The State of Virginia is probably ahead of other states in performance testing of cattle with the improvement program they have developed.

Extension Programs: In recent years, extension services in a number of states have initiated aggressive herd production-testing programs based on real evidence of the advantages to be derived from such a program. These are gaining momentum and even though they were a bit slow to get underway, there is every reason to believe the work will continue to grow at an accelerated pace.

Endorsement by Breed Associations: Breed associations are belatedly coming out in favor of production testing--some not wholeheartedly but at least they are beginning to get in step. All of these factors and others are helping to swing the pendulum toward a sounder beef cattle breeding program.

As to our present status, perhaps the most important contribution of performance and progeny testing in beef cattle, insofar as the individual cattleman is concerned, has been to demonstrate the fact that the simple operation of keeping production records on the herd and having the intestinal fortitude to use those records in a selection program will work wonders on the productivity of that herd. Equally important, as a by-product of record keeping, is the improved management which results from the information obtained by the records. Record keeping has pinpointed weaknesses in management, year-round feed supply program, disease and parasite control, and others. It is entirely possible that improved management resulting from

record keeping actually may be the greatest contribution of the production-testing program, at least in the initial stages.

Environment: As we move forward from our present status and attempt to coordinate the efforts of our improvement program on a national basis, we are confronted with the matter of standards of performance as they relate to environment and systems of production. Desirable as it may be to have one set of standards of minimum performance on a nation-wide basis, it has shortcomings and disappointments in its practical application. We must not lose sight of the importance of environment and its relation to performance. We have extremes of climatic conditions and quality and quantity of feed, differences in market outlets, and differences in consumer preference in different parts of the country. Within these specialized areas we have circumstances which in the final analysis make each and every individual farm and ranch different. In other words, a breeding program based on performance must consist of selection of those animals which perform best under a specific set of environmental conditions peculiar to that particular operation. Whether the performance meets state or national standards is incidental insofar as the individual producer is concerned. He must have performance at a cost of production which will permit him to stay in business, and this performance must be made under his set of conditions. We should take a leaf from the book of the Dairy Herd Improvement Association records which tell us that environment makes up about 90 percent of the variation in milk yield. Is it equally important in the beef enterprise?

Grading: Another problem confronting the beef cattle industry is our current standards for government beef grading. Of the beef that was graded in 1958, only 4 percent graded Prime, 40 percent Choice, 26 percent Good, and the rest Standard and Commercial. In 1948, Prime was graded down to make it a working grade. It is still not a working grade. Government beef grading standards as they exist today are a road-block to progress in beef cattle improvement. Cattlemen, as well as consumers and processors, are aware of the need for revision of government beef-grading standards. It will require the thinking of all segments of the industry to bring about revisions which will better serve all segments of the industry. With the trend to preference for red meat and corresponding discrimination against fat, it should be obvious which way the revision of present grading standards should be directed.

What About the Future?

In light of what we have seen in the past, and our current status, it seems safe to assume that the future will bring fewer and larger units, continued growth in size of feed-lot operations, and the need for utilizing every tool available to keep production costs in line, if beef is to remain competitive at the market place. If this is true, then the cattlemen who are using records of performance as a guide in their selection of breeding animals will be the ones who remain competitive.

Perhaps the most important and the most complex problem confronting beef cattle improvement at the moment is the need for accurate, on-foot criteria of the red-meat animal. Significant differences do exist within herds and within families of cattle in their ability to gain and in the lean-fat ratio of those gains. Until we are able to accurately evaluate these differences in lean-fat ratio on foot, the rate of improvement will be retarded. We have seen ample evidence of the inability of the human eye to distinguish the red-meat steer from the average wastey steer in carcass contests held in connection with our major livestock shows.

Specification Trading: With the growth of our big food chains, which specialize in one grade of meat and which today are handling over 50 percent of the retail meat, we are seeing a trend toward specification trading in meat. This emphasizes the need for standard grades as well as standard products in terms of weight, meatiness, amount of fat, and general quality. That this specification trading of meat at the wholesale and retail level will have an impact on the producer operation is obvious. Reputation herds of established performance levels of rate and economy of gain as well as carcass characteristics will be a part of this specification trading in beef from producer to consumer. Cattlemen whose herds are catalogued as to productivity, performance, and carcass value will fit into the scheme of trading as we look to the future. This pattern of production will be advantageous and profitable to the producer who is prepared to supply what the trade demands.

Tenderness: Since the average consumer places tenderness at the top of the list of requirements for desirable meat, it is apparent that we need to focus attention on producing more tender beef. Undoubtedly, this is in part hereditary, but selection for tenderness, important as it may be to the consumer, is not necessarily a safe guide to the producer. Cattle producing the most tender meat are not necessarily most profitable or best doers for the producer. Perhaps the fact that we are producing younger market cattle will go a long way toward satisfying consumers on tenderness. We should not overlook the possibility of tenderizers leveling out differences in tenderness in the future.

Carcass Evaluation: There is need for greater emphasis on carcass evaluation as it relates to live-animal characteristics and performance. The two must be correlated if we produce the red-meat animal profitable to all segments of the industry. We cannot separate producer needs from consumer requirements. The need for criteria for on-foot evaluation of breeding animals which will produce the red-meat steer of tomorrow is apparent. I trust greater emphasis will be directed toward this end in research of the future. There is opportunity for research personnel at experiment stations to work more closely with the meat industry. I am convinced that many meat processors are sufficiently concerned to be interested in cooperative research of this nature. We should exploit this opportunity.

Dr. Bogart:

Dr. Warwick can see beef cattle research from the standpoint of the man doing actual research, and as a person who is ever looking over the entire program and can see what needs to be done.

Dr. Warwick:

In appearing third on this program, and after having listened to the discussions of State reports this morning, I find some of the things I had intended to say have already been said. I hope I may be excused if I repeat some things.

As I look at this problem, we are as researchers primarily interested in accumulating information which can be adopted and used by the breeder of beef cattle to improve his production. Secondly, we hope to produce some good cattle. With modern techniques, particularly those of artificial insemination, it is quite possible some of the cattle produced in research herds will have a great impact on industry. However, our greatest potential contribution is in developing methods which breeders can use.

The time might best be spent by pointing out my ideas of problems for which producers will be wanting answers.

The producer may ask, "How much progress can I make and how fast can I make it?"

If we select for one character only, we might answer about as follows:

Weaning weight: Probably we could make average annual progress of somewhere around 3-1/2 pounds.

Postweaning gain: We might make an annual progress of .05 pound in average daily gain.

Conformation score: Annual improvement of .06 of grade.

If we select for all three at once, the expected annual progress would go down to:

Weaning weight	2.0
Postweaning gain	.03
Conformation score	.04

If you project an annual progress of 2.0 pounds in weaning weight over a ten-year period, that is 20 pounds or, in relation to present national averages, about a five percent improvement. This, presumably, would be largely net, so it would mean very much to the industry to make improvement at that rate.

Can we expect to make progress of this kind over a considerable period of time? There are several things that could make these figures too optimistic. There may be negative genetic correlations, that is, in selecting for one trait we automatically select against another. As research workers, one of the biggest things we are faced with is determining whether or not there are negative relationships among important traits of beef cattle, and if so, how large they are.

If genetic-environmental interactions are important, the cattle we select on a given farm or ranch in a given year might not even perform as well on the same ranch in another year without considering where they might rank if taken to a completely new environment in a new area. Information from herd data can be studied for evidences of interactions. I believe the importance of the question justifies putting more emphasis on analysis of our data from this standpoint than has been done to date and also justifies setting up experiments specifically to study it.

The real answer to questions on effectiveness of selection will have to come from long-time selection studies. These studies must be set up with specific objectives and based on objective measures for which selection can be made on a uniform basis over long periods of time. I am glad a few such studies are now being initiated.

Perhaps the most frequent questions I get from producers relate to crossbreeding or, to put them in technical terms, to heterosis or hybrid vigor. In spite of all the research on breeding systems, we still have a pretty poor idea of the amount of hybrid vigor that can be expected from crossing the three British breeds of cattle and from crossing inbred lines of these breeds. We have more information on crossing Zebu types in the South than we have on crossing among the British breeds. Experiments now under way will give at least partial answers on crossbreeding.

Information is gradually accumulating on possible usefulness of inbred lines for crossing and top-crossing.

In my opinion, one of our prime research objectives should be to get thorough evaluations of the usefulness of existing lines on which considerable time, effort, and money have been spent in development. From the commercial breeder's standpoint, information is needed on whether using inbred lines in controlled crosses will give better performance than he will be able to get through the selection process.

Another commonly asked question relates to efficiency in beef production. This is a broad term but, if we restrict it to questions on efficiency of feed utilization, we must admit it is a question on which we have relatively little information. Grossly, there seems to be considerable correlation between rate of gain and efficiency, but taking into account possible differences in composition of gain, we have only limited confidence in those

figures. Further, there are indications of genetic differences in efficiency over and above what we account for by rate of gain. The problem also needs study in relation to hybrid vigor.

It is interesting to visit with some of the people who are promoting new and unusual kinds of cattle. They all tell us their cattle are more efficient and, if this is true, they have a favorable factor working for them. However, before we accept these claims, we need more good research information than is available to date.

Questions relating to carcass quality are some of the most important things facing us in research. From research done so far, there are enough straws in the wind to indicate that it is possible to produce beef with good eating quality without excessive fat. We can accomplish something in improving carcass traits through application of progeny-testing techniques. These techniques are very slow and we would make much more rapid progress if we could develop ways and means of predicting carcass composition from the live animal.

I have not mentioned improving fertility. Certainly that is one of the very biggest research needs. The average calf crop in the United States is somewhere around 80 percent. If we could increase that by even five percent, it might well be more important than any other thing we could do.

To conclude, I would like to repeat my belief that our primary function is to accumulate information which as scientists we must insist be just as sound and complete as possible. However, we must recognize that in many cases the industry is going to be using and applying our techniques before we have as much background information as we would like. Particularly in the face of industry interest in performance testing, it is necessary that we as research people work closely with industry and Extension personnel giving them the very best information we have but at the same time emphasizing to them that these procedures which we think now are good are likely to be improved in the future. I hope we never close the door on the improvement of techniques which the industry applies to beef cattle breeding.

Dr. Burris:

You said our primary approach is to accumulate information. Is that our primary purpose, or is it somewhat broader?

Dr. Warwick:

That is my definition of the research man's job doing work in beef cattle breeding. We also hope to develop some cattle that are also useful.

Dr. Burris:

Where the objective is simply gathering information, not drawing conclusions?

Dr. Warwick:

To my way of thinking, gathering it and publishing it with an interpretation is part of what I meant.

Dr. Cobb:

Dr. Miller, what is your opinion on these tenderizers?

Dr. Miller:

Not having used them, I have an opinion that would mean very little, but I have been told by people in the know that widespread use of the tenderizers is to be expected in the food industry.

Dr. Kincaid:

They have a long way to go before tenderizers help much in beef.

Dr. Stonaker:

How do the Directors feel about trying to produce cheaper beef? Are we on the way out on this kind of project, or where are we? Certainly, there is nothing on the horizon to make us think people want to put more money into this research.

Dr. Wheeler:

It sometimes bothers me in terms of our objectivity in a program of this type. This carcass quality that Jack talked of is the matter that bothers me most. We are making progress in the matter of efficiency of production. But we must direct our efforts toward a better product. And how do we measure it, particularly from the standpoint of the consumer? Here is an area where all of you in beef cattle work must do some potent thinking. Is an efficient steer the better steer in the mind of the consumer? Does he have a better type of meat that the consumer would prefer to another type of meat? I have no suggestions that would be particularly helpful, but I feel we are floundering a little at this time.

I feel reasonably sure that if we are to be really productive in a long range effort started from a genetic point we are going to have to look long and hard at the carcass from the consumer end. I am very much concerned in my own mind as to just what the consumer wants and how we are going to get the job done.

Mr. Williams:

As you know, I have worked with the Research Planning Conference for a good many years. Dr. Stonaker infers a lack of pressure from industry. I do

not feel that is true in Oregon. In this very building last year prior to our legislature I saw commercial people with one clamor and that was, give us a cheaper operation. We have a diminishing region in Oregon. We have a productive capacity that is going out in too much competition. It is not a matter of overproduction. Here, on the West Coast, we are producing to our own market. We will probably continue to. But we must have more efficient production, not to produce more, but to be allowed to produce at a profit. Sure, beef cattle units will have to be bigger--more income per animal unit. But I think you are wrong in saying the industry is not asking for efficiency. We do not say we want greater production, but we want the right as operators to operate more efficiently. That is why we must be right as to what type we must produce. You must guide us, and you must tell us how to do it efficiently, or what is the same thing, into cheaper operations.

Dr. Rollins:

How homogeneous is the consumer class? Does the family on a \$5,000 income want the same quality as the family on a \$20,000 income? Does one set of consumers want Commercial grade? As research workers we have to keep an eye on getting useful information, and industry will have to decide how it is to be used.

The meeting adjourned and the group proceeded to Avery Park where an excellent salmon barbecue was provided for the W-1 Technical Committee, Western Directors, and guests.

Joint Meeting

Western Directors and W-1 Technical Committee

Dr. Bogart welcomed the Western Directors, and stated that the purpose of the meeting was to present a review of beef cattle breeding research under W-1 during the past ten years. In order to accomplish this, various topics had been assigned to speakers. A question and answer period, moderated by a discussion leader, would follow each presentation.

Dr. Bogart read the original and present objectives of the Regional Research Project.

Objectives of the project as approved in 1947:

1. The development of inbred lines of beef cattle that will be useful in the improvement of such characters as rate of gain, economy of gain, carcass quality, fertility, and longevity
2. To develop effective breeding techniques for improving the productiveness of beef cattle
3. To investigate the productiveness of existing lines of beef cattle

Objectives from Regional Research Project revised January 1956:

1. To develop lines of established beef cattle breeds that will be useful in the improvement of economically important characteristics such as weaning weight, rate of gain, economy of gain, carcass composition, fertility, and longevity
2. To develop selection criteria and selection and breeding techniques which will be effective in the derivation of productive lines of beef cattle

A joint meeting of the W-1 Technical Committee and the Western Directors was held the evening of July 8 for the purpose of reviewing beef cattle breeding research in the Western Region during the past ten years. The following papers were presented:

Inbreeding and Line Development H. H. Stonaker

Introduction

Development of lines of cattle with varying degrees of inbreeding has been a starting point for cattle breeding experiments at many of the Western stations. In some cases inbreeding is a necessary evil if continued control of observations on parents of progeny under one environment is to be possible. In selection experiments, a degree of inbreeding is necessary if the chances of decreasing or washing out the selection pressure by bringing in outside breeding animals is to be avoided. This general program is well outlined by Knapp, Church, and Flower (1951). There are, on the other hand, in progress modifications of the procedure. Also in practice is the development of more lines with fewer animals per line accompanied by more intense inbreeding but probably less selection pressure. In this case, rotational crossing of lines for commercial purposes would be followed. If heterosis is generally important in beef cattle, one would expect increased opportunity for finding superior combining abilities by having more rather than fewer lines for this sifting. In all lines that have been formed, selection for performance characteristics has been followed, although it varies in procedure. Differences in selection pressures obviously must occur within the many lines at the Western stations. In the over-all work of the 12 Western states, there are 53 lines of cattle including 1,743 bulls and cows. Station herds include 3,411 purebreds and 1,509 grades. Cooperating herds include 1,249 purebreds and 735 grades. This equals a total of 6,954 animals being used for research in this region.

Abnormalities Uncovered in the Inbreeding

Very few striking abnormalities or lethals have been reported in the development of the inbred lines at the various stations. At the New Mexico station, a lethal has been reported (Blackwell, 1955) in which internal hydrocephalus and closure of the supraorbital foramen were the anatomical abnormalities. At the Colorado station (Stonaker, 1958) spastic calves were found in one line, abnormalities of the eyes including cross eyes and double eyelids in another line, and sex abnormalities have been indicated in heifers from inbred lines. In the case of the Colorado station, these striking abnormalities while not sufficiently frequent to be subject to analysis have occurred only in the inbred calves. At the California station two anomalies have been reported (Rollins, 1956). One of these was "depressed temple", and the other was "double cervix". Dwarf calves or calves suspected of being dwarfs have occurred in a sprinkling of lines in W-1. Frequency of occurrence within these lines appears to have been low.

It should be emphasized that these infrequently-occurring abnormalities are suspected of having a genetic basis but have not actually been sufficiently frequent to permit genetic analysis. A number of papers from the Region on dwarfism have appeared, but the lines themselves have been used more for the trying of techniques for detecting heterozygotes than for testing genetic hypotheses.

Antigen Loss With Inbreeding

Blood antigen studies by Stroble, Mason, and Hilston (1954) at Wyoming, and by Kushwaha, Ferguson, and Stonaker (1954) in the Miles City, Montana, and Colorado Experiment Station herds indicated line differences in both occurrence and frequency of occurrence of blood antigens. The Wyoming analysis of Miles City cattle also indicated greater duplication occurrence within some lines than in others. This was used as evidence of greater inbreeding within some lines than others. In the Colorado study, a different approach was taken--that of antigen occurrence within line relative to the inbreeding of the animals within the line. Regression of rate of loss of antigens on inbreeding was computed and found to be significantly greater than expected from the rise in inbreeding coefficients (Kushwaha, 1953).

These results which are in general agreement with the theoretical expectations from inbreeding have served more conclusively than any other genetic source of material to indicate that the actual effects of inbreeding are closely correlated with the theoretical concepts as developed by Sewall Wright.

Fertility of Bulls

Semen evaluations in bulls from inbred lines, line crosses, and standard outbreds indicate that more highly significant differences in the estimated fertility levels, and a significantly higher percentage of "unsatisfactory" bulls have been found in inbred lines than within the line crosses (Harris, Faulkner, and Stonaker, 1953), (Reference Table 4). Line crosses have been appreciably superior in their classification to outbred bulls from breeders' herds where these yearling bulls have been on the same feed for at least five months previous to testing. There are significant differences in morphology grades given sperm in the three groups. This suggests increased problems due to the somatic environment of the sperm cell arising from the more nearly homozygous parent rather than due to the higher frequency of occurrence of genetic incompetence insofar as the sperm cells themselves are concerned. This seems a more acceptable hypothesis concerning the cause of morphological differences since there should be no average genetic difference between the populations of the haploid sperm cells from inbred lines and populations of the haploid sperm derived from hybrids of those lines.

Inbreeding As It Affects Reproductive Rate

Woodward and Clark (1959) indicate an appreciable increase in the number of stillbirth deaths for inbred lines in contrast to the outbred group (Table 1). The stillbirths appeared to increase in frequency as the degree of inbreeding rose (Reference Tables 2, 3). In the Montana data, the influence of maternal environmental effects which may be influenced by the inbreeding was not separated from the variations in the inbreeding levels of the calves. Thus, it is not clearly understood how much of this inbreeding effect may be due to the low vigor of the dam and how much to the low vigor of the calf. The over-all net effect is clear, however, and that is that inbreeding in these lines at the Miles City station has resulted in a greater incidence of stillbirths. Whether these definitely can be defined as lethals, as such, would depend upon the importance of the maternal environment in causing stillbirths. Similar results have been observed at the Colorado station (Reference Tables 5 and 6) when the inbreds are compared with line crosses. A 14 percent difference in calf crop of inbred two-year-olds and line-cross two-year-olds was found for the period 1958-59, and a 12 percent difference was noted in the comparison of inbreds and line-crosses which were three years of age and over. Again, the results are not in a form to derive whether this is due to lethals in the inbred calves themselves or whether it may be more the result of an inferior maternal environment of the inbred dams. Inbreds and line-crosses were sired concurrently by inbred bulls. The bull effect, as such, should not have an influence on the relative calf crops indicated for inbreds and line-crosses. The over-all genetic effects seem to be clear-cut, however.

At this time, then, analyses do indicate a deterioration in semen evaluation, a higher rate of stillbirths, and a lower calf crop from the inbreds than from outbred or line-cross stock.

Size, Growth, and Feed Utilization

The Miles City*, New Mexico, and Colorado stations have presented data on the effect of degree of inbreeding on weaning weights, daily gains, and feed efficiency of bulls on feed. McCleery and Blackwell (1954) found an appreciable loss in the weaning weight with each percent of inbreeding (Reference Table 7). Calves equivalent to 25 percent of inbreeding would be expected to be 16 pounds lighter than noninbred calves. Grades in the New Mexico study also were adversely affected by increased inbreeding. Where inbreeding of dam was considered along with inbreeding of calf, partial regression coefficients were +.95 for inbreeding of dam and -1.19 for inbreeding of calf. In Colorado studies, the weaning weight was adversely

*Koch (1951) using Miles City data found a regression in weaning weight of -2.54 pounds per percent of inbreeding of dam and -.43 pound per percent of inbreeding of calf.

affected by both the inbreeding of the calf and the inbreeding of the dam. The inbreeding of the calf appeared to have the greater effect in studies by Burgess, et al. (1954) than did the inbreeding of the dam. Correction terms were developed from the study by Burgess using data from the Colorado Experiment Station. His adjustments were developed from solutions of simultaneous equations. They were -1.76 pounds for each 1 percent inbreeding of the calf and -1.17 pounds for each 1 percent inbreeding of the dam. Thus, a 25 percent inbred calf out of a 25 percent inbred dam would be expected to be 72 pounds lighter at weaning than a noninbred calf from a noninbred dam.

The results of these applications for subsequent years of calving are shown (Reference Table 3). As can be seen here, apparently the inbreeding corrections developed from the 1946-51 data were too great for the effects noticed from 1952 to the present.

Daily gain appears to be only slightly affected by the inbreeding as indicated in a recent study at the Colorado station by Moore (1958). The constants derived were for year, age of calf, weight of calf, and line of breeding. The inbreeding constants found for daily gains of bulls relative to inbreeding level were $F_{0-.09} = -.01$; $F_{.10-.19} = +.06$; $F_{.20-.29} = 0$; $F_{.30-.39} = -.03$; $F_{.40-} = -.03$. The effects are variable but for the most part seem to be negative, although they are not great nor do they seem to be cumulative. Blackwell (1957) found significant negative association of gain with inbreeding but only slight effect of inbreeding on final weight. TDN required per pound of gain increased with inbreeding.

Independent Variable	Dependent Variables		
	Final Weight	Daily Gain	TDN Per Pound of Gain
Inbreeding percent	-1.59	-.0117**	.0268

At the Havre station (Willson, 1958) it was found that the Miles City line (more highly inbred) has gained less than line-cross steers, and cross-line heifers have produced heavier weaning calves than Line 1 controls. At the California station, Rollins (1958) has reported faster gains for line-cross calves than for inbreds but little difference in efficiency.

Insofar as general means are concerned and where the bulls were fed on a time-constant basis, the more highly inbred bulls at Colorado have shown slightly greater efficiency of feed utilization than have their line-cross brothers. At the Colorado station, the indications have been that the efficiency of inbred bulls was about 2 percent less than that of line-cross bulls. These effects were not large or significant and may reflect almost entirely previous environmental influences. The inbred bulls were lighter and thinner when they began the feed test.

It would be expected from the results thus far that selection for such traits as daily gain and efficiency should be effective even though the cattle are being inbred. The theoretical handicaps would be lessened selection differentials and decreased genetic variability or decreased heritability due to the inbreeding process. On the other hand, for such things as fertility or weaning weight where inbreeding depression appears to be appreciable, it seems less probable that the amount of selection pressure exerted and the lower heritabilities involved would make it possible to successfully counterbalance the inbreeding degeneration expected. Apparently, in the large lines at Miles City, the automatic selection against such things as stillbirths has not successfully counteracted the inbreeding degeneration taking place. The cattle-breeding projects thus have been the source of these questions some of which may never be answered on cattle in themselves. For perhaps the most economically important traits of all--the factors involving the calf crop--heritability estimates are generally not available. It is expected from other evidence that they will be low and the very fact that the inbreeding depression appears to be greatest in these traits would also indicate this. Heterosis effects for these traits are at present indicated to be appreciable. Results to date would certainly indicate that it would be unwise to neglect the heterosis aspects in our experiments. In those traits more evasive of heritability analyses, or likely to be low in heritability, still may lie the richest "pay dirt" insofar as the geneticists' potential contribution to the cattle industry is concerned.

Table 1.--Stillbirth incidence in inbred lines and a test herd (1936-57)

Herd	All Births	Stillbirths	Percentage Incidence
Line 1	1,822	82	4.5
All other lines	2,708	114	4.2
Test herd	4,261	120	2.8

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Table 2.--Incidence of stillbirths in Line 1 by inbreeding of dam (1936-57)

Item	F _x of Dams					
	0-6	7-12	13-18	19-24	25-30	31-)
Number of live births	611	334	584	186	25	10
Number of stillbirths	12	17	35	12	5	1
Percent stillbirths	1.9	4.8	5.7	6.1	25.0	9.1

Woodward and Clark, J. An. Sci. 18 (1)

Table 3.--Incidence of stillbirths in Line 1 by inbreeding of calf (1936-57)

Item	Ex of Calves					
	0-6	7-12	13-18	19-24	25-30	31-)
Number of live births	189	338	777	311	80	45
Number of stillbirths	8	12	27	19	10	6
Percent stillbirths	4.1	3.4	3.4	5.8	11.1	11.8

Woodward and Clark, J. An. Sci. 18 (1)

Table 4.--Breeding soundness of yearling bulls (1955-57)

3-Year-Average by Breeding Group	No.	Percent of Bulls in Each Category	Av. Age in Mos.	Watch Ques. or Unsatisf. Physi-cally	Av. Grade Per-cent Motil-ity	Av. Grade Rate Motil-ity	Av. Grade Conc.	Av. Grade Mor-phology	Av. Per-cent Alive
<u>Inbreds</u>									
Satisfactory	47	65.3	12.9	0	3.3	3.8	2.7	3.5	68
Questionable	9	12.5	12.7	1	2.8	3.4	2.3	2.0	60
Unsatisfactory	16	22.2	12.6	6	2.3	3.1	1.6	1.6	35
	72		922.2		217.1	258.8	173.2	208.1	4,296
			12.8		3.0	3.6	2.4	2.9	60
<u>Linecrosses</u>									
				(Watch)					
Satisfactory	71	81.6	12.8	(2)	3.4	3.9	2.5	3.6	67
Questionable	10	11.5	12.7	4	2.8	3.9	2.1	1.9	71
Unsatisfactory	6	6.9	12.5	4	2.0	3.2	1.8	1.6	57
	87		1,110.8		281.4	338.6	209.3	284.2	5,809
			12.8		3.2	3.9	2.4	3.3	67
<u>Outside</u>									
Satisfactory	40	64.5	13.1	0	3.5	3.9	2.7	3.5	69
Questionable	14	22.6	13.0	2	3.0	3.9	2.5	2.3	64
Unsatisfactory	8	12.9	13.1	5	2.5	2.8	1.6	1.9	47
	62		810.8		202.0	233.0	155.8	187.4	4,032
			13.1		3.3	3.0	2.5	3.0	65

Colorado (Unpublished)

Table 5.--Calf production of inbred and line-cross Herefords by year and line of calf's sire

Year	Inbreeding Cows Calves	Inbreds			Line-crosses*									
		No. Ex- posed	No. Raised	% Raised	No. Ex- posed	No. Raised	% Raised	No. ex- posed	No. Raised	% Raised	No. ex- posed	Calves Raised	% Raised	
1951	.13	18	9	50	65	48	74	15	8	54	92	75	82	
1952	.19	27	10	37	65	41	63	19	12	63	69	61	88	
1953	.20	20	7	35	89	61	69	20	12	60	60	57	95	
1954	.19	26	14	54	69	61	88	26	16	62	81	68	84	
1955	.22	8	6	75	47	40	85	11	6	67	64	56	86	
1956	.25	12	8	67	57	44	77	19	12	63	71	61	85	
1957	.24	9	2	22	64	41	64	15	7	47	95	74	78	
1958	.24	16	7	44	69	50	72	8	6	75	89	79	89	
Total		136	63	46	525	386	74	133	79	59	621	531	86	

* Approximately 5 percent inbred

Colorado (1951-57)

Table 6.--Summary: Calf production of inbreds vs. line-crosses by lines of calf's sire (1951-58)

		Inbreds										Line-crosses									
		Two's			Three's and Over			Two's			Three's and Over										
Line of Calf's Sire	Cows Ex- posed	Calves Raised	% Raised	Cows Ex- posed	Calves Raised	% Raised	Cows Ex- posed	Calves Raised	% Raised	Cows Ex- posed	Calves Raised	% Raised									
Brae Arden	18	8	44.4	71	62	87.3	15	6	40.0	76	67	88.2									
Bonanza	7	3	42.8	27	16	59.3	14	9	64.3	48	37	77.1									
Colorado	12	8	66.7	49	39	79.5	12	6	50.0	55	49	89.1									
Don	6	4	66.7	42	25	59.5	16	13	81.2	58	49	84.5									
Ft. Lewis	19	7	36.8	33	23	69.7	7	6	85.7	28	25	89.3									
La Plata	12	8	66.6	27	21	77.8	4	4	100.0	30	26	86.7									
Mesa	1	0	0	37	24	64.9	10	3	30.0	40	30	75.0									
Monarch	6	2	33.3	37	32	86.5	9	6	66.7	45	40	88.9									
Prospector	10	5	50.0	42	32	76.2	12	9	75.0	64	56	87.5									
Real Prince	4	0	0	12	44	33.3	1	1	100.0	6	4	66.7									
Rover	0	0	-	0	0	-	1	0	0	18	15	83.3									
Royal	21	10	47.6	51	40	78.4	14	6	42.9	49	41	83.7									
San Juan	17	7	41.2	61	40	65.6	10	6	0.0	77	67	87.0									
Verde	2	1	50.0	2	18	78.3	8	4	50.0	18	16	88.9									
Tarrington	1	0	0	13	10	76.9	0	0	-	9	9	100.0									
Total	136	63	46.4	525	386	74.0	133	79	60.0	621	531	86.0									
Control Hereford	15	8	53.3	42	31	73.0	Crossbred Controls 4	4	100.0	14	10	71.0									

Table 7.--Estimates of the factors affecting weaning weight and grade. Partial regression coefficients with their standard errors (in parenthesis), standard deviations of the traits and their associated degree of freedom

Trait	Age of Calf	18-Month Weight of Dam	Sex of Calf	Inbreeding of Calf	Inbreeding of Dam	Standard Deviation	d.f.
Weight ^{1/}	1.17** (.045)	0.11 (.019)	26.31** (2.129)	-0.74** (.266)	-- --	40.25	1437
Grade ^{1/}	-.005** (.001)	-.001** (.0004)	-.030 (.047)	-.001 (.0058)	-- --	0.381	1437
Weight ^{2/}	1.16** (.061)	0.13** (.028)	24.61** (2.361)	-1.19** (.339)	0.95* (.433)	50.75	1257
Grade ^{2/}	-.005** (.001)	-.001** (.0005)	-.007 (.048)	-.013* (.0066)	.010 (.007)	0.857	1257
Weight ^{3/}	1.17** (.045)	0.10** (.020)	26.15** (2.052)	-0.63* (.307)	-- --	37.16	1345
Grade ^{3/}	-.004** (.001)	.0003 (.0005)	-0.048 (.047)	.006 (.0076)	-- --	0.849	1345

1/ Estimates based on pooled data within years (1940-53) ignoring inbreeding of dam

2/ Estimates based on pooled data within years (1943-53) including inbreeding of dam

3/ Estimates based on pooled data within sires and years (1940-53) ignoring inbreeding of dam

** Significant at 1 percent level of probability

* Significant at 5 percent level of probability

(McCleery and Blackwell, 1954). Amer. Soc. Anim. Prod. West. Sect. Proc. 5:223-227.

Table 8.--Actual and adjusted weights of Hereford calves (1952-57)

	M	No. F	Calf		Dam		Calf		Dam		Actual		Adjusted	
			M	F	M	F	M	F	M	F	M	F	M	F
<u>Inbreds</u>														
1952	18	23	228	220	4.4	3.7	31	29	21	19	395	339	439	420
1953	30	27	205	196	4.0	4.0	31	29	22	19	394	370	483	487
1954	39	36	194	193	4.4	4.4	31	31	20	22	397	358	496	485
1955	25	20	192	192	4.2	4.8	32	32	22	22	398	336	507	464
1956	27	25	191	186	4.8	4.7	35	33	26	23	363	330	496	477
1957	22	21	201	200	5.7	5.6	33	35	22	23	415	377	505	497
Total	161	152	1211	1187	27.5	27.2	193	189	133	128	2362	2110	2926	2830
Mean			202	198	4.6	4.5	32.1	31.5	22.1	21.3	394	352	488	472
<u>Linecross</u>														
1952	36	29	224	229	4.5	4.3	.05	.05	.05	.05	405	395	395	403
1953	30	20	208	196	3.6	4.4	.05	.05	.05	.05	447	420	469	468
1954	35	44	199	195	3.9	3.7	.05	.05	.05	.05	427	377	450	432
1955	27	35	191	195	4.1	4.2	.05	.05	.05	.05	443	412	481	464
1956	39	34	194	196	4.6	4.4	.05	.05	.05	.05	403	378	433	430
1957	34	41	203	205	5.1	5.2	.05	.05	.05	.05	430	414	442	441
Total	201	203	1219	1216	25.8	26.3	.30	.30	.30	.30	2555	2396	2670	2638
Mean			203	203	4.3	4.4	.05	.05	.05	.05	426	399	445	440
<u>Control</u>														
<u>Hereford</u>														
1955	4	6	203	206	2.2	2.3	0	0	0	0	376	339	402	380
1956	6	5	201	210	3.2	3.6	0	0	0	0	410	359	424	381
1957	3	5	195	203	4.0	4.0	0	0	0	0	398	384	424	418
Total	13	16	599	619	9.4	9.9	0	0	0	0	1184	1082	1250	1179
Mean			200	206	3.1	3.3	0	0	0	0	395	361	417	393
<u>Crossbred</u>														
<u>Control</u>														
1957	3	3	188	198	2.3	2.3	0	0	0	0	393	430	445	487

(Stonaker, 1958. Breeding for Beef. Colo. Agr. Expt. Sta. B. 501-S)

Dr. Rollins - Discussion Leader:

I should like to suggest that the questions and discussions be organized in terms of the future--what future uses might be made of these inbred lines that have been developed in the region. The floor is now open for discussion.

Dr. Bogart:

Dr. Stonaker has done a lot of combining inbred lines. What has been your experience with these line-crosses and the use of inbred bulls on outbred material?

Dr. Stonaker:

I think we have practically nothing on line-crosses.

Dr. Bogart:

Have you had any inbred bulls on outbred material?

Dr. Stonaker:

Yes. Generally speaking, it looks very good.

Dr. Bogart:

Are the better inbred lines the better combiners on outbred material?

Dr. Stonaker:

That is true on things that are highly heritable. I might add that I did not bring out any of the laboratory work done as background material.

Dr. Rollins:

I would like to throw out an idea I have been kicking around. It might be advisable for W-1 to undertake the cataloging of W-1 lines for inbreeding and performance. Then, too, the possibility of establishing a frozen semen bank, if our lines were cataloged and if the bank should be established this might be of help in future planning.

Dr. Burris:

What manner of selection has been made in the inbred lines we have? The criteria of selection, etc.

Dr. Rollins:

In most inbred lines, there has been selection within the lines, and in fewer instances selection between lines. Perhaps Ray Woodward would be the one to talk on that. Haven't you eliminated some lines on basis of performance?

Dr. Woodward:

Yes. On basis of performance plus losing the lines.

Dr. Burris:

How receptive are the commercial breeders in the West in accepting these inbred lines as sources of breeding material?

Dr. Woodward:

We have had to close our books. We sell by private treaty in the order in which requests are received. We have had a very good demand.

Dr. Clark:

Stonaker has probably sold at public auction more inbred bulls than all the other stations put together.

Dr. Stonaker:

Our breeders are requesting we sell around 60 bulls a year, but those are not all inbreds. If ranchers are convinced we have something, they will come buy it.

Director Ensign (Idaho):

How many established inbred lines are there?

Dr. Stonaker:

There are 53 lines in the Western Region. The two stations with the largest number are Colorado and the U. S. Range Station at Miles City, Montana.

Dr. Warwick:

What is your observation on effectiveness of selection in these small lines? Will a small line retain the characteristics they have?

Dr. Stonaker:

I believe our lines are jumping around more than bigger lines. Our lines have jumped around quite a lot.

Dr. Clark:

Had you anticipated that?

Dr. Stonaker:

I thought it would be the other way around.

Interrrelationships Between Traits
R. R. Woodward

Practically all of the cooperating states have contributed to some phase of these investigations. Most of the work to date has been concerned with interrelationships between production traits as expressed by phenotypic correlations. Emphasis now is shifting to possible interrelationships between production and carcass traits.

Our interest in the interrelationship of traits is, of course, due to the fact that more than one, and in fact many, traits of beef cattle are of economic importance. We recognize that we should limit to the greatest possible extent the number of traits for which we select. Nevertheless, the minimum number of traits in which we should be interested are--growth, efficient feed conversion, soundness, fertility, and the traits which make a desirable meat quality. Therefore we are faced with the necessity of determining how selection for any one of these traits will affect the others--either positively or negatively.

In this review of the accomplishments in W-1, I have elected to summarize the information we have obtained in chronological order. Briefly, here are some of the things we have learned.

Considerable investigation has been conducted with prenatal growth as measured by birth weights. In general, prenatal growth is related to postnatal growth, but not such traits as efficiency of feed conversion, or subsequent grade. There is apparently a slight relationship with lean, but none with yield, carcass grade, or tenderness. There are apparently no negative associations with other economically important traits.

Growth to Weaning

Reports from a number of studies agree that there is a low positive relationship with subsequent growth. Rollins and Guilbert reported that lactation has a major effect upon growth of calf during the entire suckling period. Lindholm and Stonaker state that weaning weight and average daily gain are traits most closely related to net income in calf raising and feeding operation. Again there appears to be little or no correlation between preweaning growth and the traits determining carcass quality.

Postweaning Growth

Much of the work on interrelationship of traits has included gain because it is a trait with high heritability and is easily measured. This work received impetus when early studies showed a positive relationship between

rate and efficiency of gain. Studies include correlations between gain and:

Other production traits - Some work has been conducted by practically all cooperating states

Carcass traits - U. S. Range Station, Nevada, Wyoming, Montana

Biochemical or physiological indices to predict future gains:

Blood amino acid nitrogen - Oregon

Rectal temps - Oregon

Heart beat - Oregon

Protein bound iodine - Washington

Interesting and worthwhile work relating feedlot and range gains was conducted at both New Mexico and Montana.

Body Form

Considerable research has been done in recent years attempting to relate body form to carcass traits. Individual measurements as well as various ratios have been considered. Nevada published to the effect that the influence of type and size in growth was much greater than on carcass traits. They also determined that certain properties appeared desirable in their effect upon carcass grade and dressing percent. Width at chest, irrespective of total size, was one of the most important traits affecting grade and dressing percent.

In general, body form has not proven to be highly related to production traits or to measures of carcass quality.

Anatomical studies at California have considered possible relationships between certain physical traits and inherited abnormalities.

Feeder and Carcass Grades

One of the important factors contributing to the impetus of ROP programs is the fact that feeder grade was proven to be valueless in predicting feed-lot performance. This zero relationship has been established at a number of stations, and it is well that it has been repeated by a number of graders. Grades show positive interrelationships--and again most of the stations have worked with this--but not high enough to be of much value. A grade at slaughter and after slaughter, for example, have a reported relationship of as low as about 0.5.

Recent work at the U. S. Range Station indicates little, if any, correlation between either slaughter or carcass grade and tenderness. Washington reported no correlation between score of dam and 180-day weaning weight.

Interrelationships of Carcass Traits

Assuming that we want more lean; less fat; a higher percentage of loin, rib, rump, and round, and increased flavor and tenderness, it appears from exploratory studies to date that none of these traits is closely enough related to growth, to feed conversion, to body form, or within themselves, to respond to anything except direct selection. Interrelationships do not appear to be high enough to improve carcass quality by live-animal selection unless it is through specific lines exhibiting superiority in any of these traits. (Data currently being printed, to be published by the U. S. Department of Agriculture and Montana).

In summary, I think this has been one of the most rewarding fields in beef cattle breeding research in the past ten years. We have particularly improved our understanding of the effects of a record-of-performance selection program upon various other traits. Low, but generally positive relationships have been reported between most of the economically important traits studied. Exceptions are certain negative associations as follows:

1. (U. S. Range Station) - Possible negative association between milk production of dam and gain in the feed lot
2. (Nevada) - Possible negative association between genes conditioning adaptability to winter feeding and ranging ability
3. (New Mexico) - Possible negative association between weaning weight and score at weaning and 18 months

Even though certain negative relationships appear, it is not unreasonable to assume that they can be broken. There are few economic traits in which genetic linkage has been established.

Apparently we can select within relatively wide physiological limits with little or no effect upon other traits. As more information becomes available on the effects of single trait selection, our knowledge of this field will be materially increased.

Dr. Cobb - Discussion Leader:

It should be pointed out in defense of W-1 that most of the work has been done on phenotypic correlations. But there have been only a few years in which there has been enough genetic material for correlation studies.

Dr. O'Mary:

On this negative correlation of milk production of dam and gain in feed lot, I would like to have that point discussed.

Dr. Cobb:

Ralph has said there probably was a compensating factor involved.

Dr. Stonaker:

Are the measurement data pretty well explored?

Dr. Cobb:

Maybe we cannot define an animal suitably by measurements. In the future, much more work will be made of genetic than phenotypic characteristics.

Physiological Approaches Under W-1
Ralph Bogart

Introduction

Physiological approaches have been designed to gather basic information on the inheritance of physiological traits. Knowledge of this nature has value in an understanding of the metabolic pathways concerned with physiological traits in estimating the possibility of concomitant selection against deleterious factors, and in their use for either increasing our accuracy in selection for productive traits or in making it possible to select for certain traits at earlier ages.

Two major problems in physiological studies are: (1) the development of methods to use, and (2) the establishment of normal values and the amount and causes of variation. A great deal of study is needed in a field such as this because so little previous work has been done. However, such information is essential before any studies can be made in which physiological findings can be used to explain variation in production traits or to study the relationship between physiological characteristics and production traits with the hope of finding physiological measurements that can aid us in our selections.

Metabolites in the Blood and Urine in Relation to Production Traits

Normal values have been established for blood levels of urea nitrogen, amino acid nitrogen, creatinine, uric acid, and creatine, and for urine levels of total nitrogen excreted per day and per unit of weight per day, urea nitrogen, ammonia nitrogen, creatinine, uric acid, and the ratio of urea to ammonia nitrogen (MacDonald, et al., 1953; MacDonald, 1954; Williams, 1954; MacDonald, Krueger, and Bogart, 1956)). These levels were determined at birth and at each 100 pounds increment in body weight up to 300 pounds. Calves on feed test show less variation from time to time and from animal to animal than while they are running with their dams on pasture and are subjected to more environmental variations.

Rapidly- and economically-gaining calves have lower levels of blood amino acid and urea nitrogen, and excrete less urea through the urine (Price, et al., 1956; Price, 1958; Price, 1958). Apparently, these animals have the ability to draw amino acids from the blood stream and build them into muscle growth. The ones that pull fewer of the amino acids from the blood stream are confronted with deamination of the amino acids and the excretion of the nitrogen fraction with the carbonaceous fraction being used for the storage of fat. All animals tend to make a shift to less use of the amino acids, less muscle growth, more excretion of nitrogen, and greater deposition of fat with increasing size. The more rapidly- and economically-gaining animal has a metabolism approaching that of younger animals while the poor-doing animals more nearly resemble the mature ones. Sex differences appear in the same direction as shifts with maturity with bulls showing a metabolism that is more like the younger animal, and heifers showing a metabolism more like the mature animals.

Breed and line differences and sex differences in the blood and urine constituents studied followed approximately the same patterns as those of rate and efficiency of gains.

Hematological Studies

Normal values have been established: hemoglobin of 12.4 g. per 100 ml. for heifers, and 11.8 g. per 100 ml. for bulls at 500 pounds body weight, and 13.3 and 13.1 g. per 100 ml. for females and males, respectively, at 600 pounds body weight (Price, et al., 1957; Price, 1956; Price, et al.,

1959). The levels at 500 and 800 pounds were positively correlated. Herefords generally were lower in hemoglobin than Angus. Calves with lower hemoglobin levels made more rapid and efficient gains.

Hematocrit percentages averaged 40.3 for heifers and 39.7 for bulls at 500 pounds body weight, and 44.5 and 43.4 for heifers and bulls, respectively, at 800 pounds. There were some line differences in hematocrit percentages, but no sex differences, and very little relationship of the levels at 500 and 800 pounds body weight.

Red cell counts per cu. mm. of blood were higher (3.25 million) at 800 pounds than at 500 pounds body weight (7.70 million) but there were no line or sex differences. The counts at the two weights were correlated. Calves with lower red cell counts made more rapid gains.

The average corpuscular volume was 53.2 cubic microns. The single corpuscular hemoglobin content was 16 micromicrograms and the corpuscular concentration was 30.3 percent. There were no sex or line differences, and these traits were not associated with performance traits.

White cell counts (total) and the lymphocytes were higher at 500 than at 800 pounds body weight. There were sex, breed, and line differences in total white cell counts, and some differences in lymphocyte counts were attributable to sex. Higher lymphocyte counts were associated with more rapid and economical gains.

Cornelius, Tyler, and Gregory (1956) have shown that short-headed dwarf cattle up to 14 months of age are normal in red cell counts and all differential white cell counts except for lymphocytes and neutrophils. They were low in lymphocyte count (55.6 compared with 63.2 for normal calves), and high in neutrophils (33.3 compared with 23 for normal calves). Hafez, et al., (1958) found that dwarfs are lower in hemoglobin, hematocrit, and white cell count than normal calves.

Blood Protein Fractionation

Normal values have been established at 500 and at 800 pounds body weight for percentages of albumen, alpha globulin, beta globulin, and gamma globulin, and for the ratio of albumen to globulin (Price, et al., 1959).

The percentages of these protein fractions were about the same at 500 and 800 pounds body weight, and there appeared to be no line, breed, or sex effects influencing these protein fractions. The percentage of gamma globulin was positively related to rate of gain.

Cornelius, Tyler, and Gregory (1956) have shown that short-headed dwarfs are normal in albumen, and alpha, beta, and gamma globulin fractions, as well as in total proteins of the blood.

Endocrine Studies

Since it is known that hormone balance influences the nature and amount of growth, it has led research workers to explore the endocrine relationships of animals differing in their inherent capacity to grow in order to find explanations relative to the manner in which inheritance brings about growth differences. Three approaches have been used: (1) determination of hormone content of glands and tissues from cattle that vary in growth rate, (2) determination of endocrine function in the live animal by isotope studies, and (3) the response of animals to injected hormones.

Thyrotropic and gonadotropic hormone contents of pituitaries from beef cattle pituitaries have shown that the more rapidly gaining animals have a higher content of thyrotropic hormone in their pituitaries than the less rapidly gaining animals (Burris, 1953; Burris and Bogart, 1953; Burris, Bogart, and Krueger, 1953; Burris, et al., 1954; Krueger, Burris, and Bogart, 1954). Beef cattle fed rations very low in protein (potatoes and straw) for 125 days had the same amount of thyrotropic hormone in their pituitaries as was present in pituitaries from animals on a normal ration (Nicholson, 1958).

Lucas, et al., (1950) found that small-type steers had smaller endocrine gland weights than large-type cattle. Thyroid and adrenal weights were correlated with rate of gain.

The hormone content of pituitaries from dwarf animals has been compared with that of normal animals. Carroll, Gregory, and Rollins (1951) presented data that indicate a deficiency of thyrotropic hormone content in the pituitaries of dwarf calves, while the pituitaries from dwarfs contained normal amounts of growth hormone and gonadotropic hormone. They postulate that the deficiency in thyrotropin might account in part for the slower growth of dwarfs. However, Cornelius, Tyler, and Gregory (1956) found that protein bound iodine levels of dwarfs were normal, and concluded that the short-headed dwarf is not a primary thyroid cretin.

Galgan, Ham, and Ensminger (1956) have preliminary results in which a higher rate of gain is associated with lower effective half-life of radioiodine and a greater urinary excretion of radioiodine. Slower gains were associated with higher thyroid uptake of iodine.

Bulls gain more rapidly and efficiently than heifers (Bogart and Blackwell, 1950; Blackwell, 1951; Dahmen, 1952; Dahmen and Bogart, 1952). Investigations have been made on the influence of injected testosterone into heifers and steers on rate and efficiency of gains (Bogart, et al., 1951; Burris, et al., 1952; Burris, et al., 1952; Burris, 1953; Burris, Bogart, and Oliver, 1953; Burris, et al., 1954). Testosterone was injected at a rate calculated from normal excretion in the human to be in the physiologically normal range of production of testosterone in bulls. This amount was

1 mg/kg body weight per week, and it was given as micropellets intramuscularly. Testosterone injections resulted in an increased daily rate of gain of 0.1 pound in steers and 0.5 pound in heifers, and a decreased feed requirement per 100 pounds of gain in steers of 41 pounds, and in heifers of 180 pounds, with no change in daily feed intake. There was marked masculinization, but palatability scores, tenderness, evaporation loss, and drip loss were not altered by testosterone administration. Testosterone caused a marked increase in protein and a decrease in the fat content of the carcass. This was particularly noticeable in heifers. As a result, carcass grades were lowered by testosterone administration.

Testosterone administration also altered the hormone content and size of certain endocrine glands (Burris and Bogart, 1953; Burris, Bogart, and Krueger, 1953; Burris, et al., 1954). The gonadotropic content of the pituitary glands was decreased by testosterone while the thyrotropic content of the pituitaries was markedly increased. Assays for these pituitary hormones were made by use of male chicks. The thyroid glands of cattle receiving testosterone were larger than those of normal comparable cattle. To assay these thyroid glands for thyroxine content required the development of an assay method.

Mice were made hypo-thyroid by giving them thiouracil in the drinking water after which graded doses of mascerated thyroid gland tissue were injected. This addition of thyroxine from the administered thyroid gland material increased the metabolic rate of the mice. To determine metabolic rates of the mice, they were asphyxiated in half-pint sealed fruit jars. The time required for asphyxiation was the inverse of the metabolic rate.

Thyroids from testosterone-treated animals contained less thyroxine than the thyroids from normal cattle. This was considered to be an indication of greater thyroxine release of these animals.

Testosterone-treated heifers generally did not ovulate as evidenced by lack of corpora lutea at time of slaughter (Burris, 1953; Burris, et al., 1954). In 24 heifers treated with testosterone, only 16 percent had ovulated at a weight of 600 pounds, whereas 100 percent of the 24 control heifers had ovulated. Methyl androstenediol, a normasculinizing male hormone, was also given at the same dosage level. The administration of methyl androstenediol at 1 mg/kg body weight per week had none of the effects reported for testosterone.

Two heifers that were injected with testosterone showed no heat cycles. However, 30 days following cessation of testosterone treatment, these heifers bred and conceived. They were given testosterone during gestation and showed no apparent ill effects until delivery when difficult parturition occurred. One calf presumed to be genetically a heifer was markedly abnormal in its genitalia, showing marked testosterone effects. (Mason, et al., 1953; Bogart, et al., 1953; Floyd, et al., 1957). It is presumed

that the testosterone injected into the cow crossed the placenta and influenced the developing heifer calf. The use of such feed additives as stilbestrol (Kercher et al., 1956; Bohman and Wade, 1958) chlortetracycline (Bohman, et al., 1957) arsenicals (Kline et al., 1949) has resulted in increased rate and efficiency of gains.

Blood Enzyme Studies

Kidwell, Wade, and Hunter (1955) studied the relation of blood glutathione level to rate and efficiency of gains. Although there was a small relation between blood glutathione level and subsequent feed efficiency, the authors conclude that this blood constituent level would not be an accurate index to rate and economy of gains.

Serum alkaline and acid phosphatase activities in calves prior to the feed test did not show any sex, line, or breed differences. Also, activities of these two phosphatases during this period showed no relation to performance traits.

Serum alkaline and acid phosphatase activities were positively correlated with rate of gain. The heifers of all lines showed a strong correlation between alkaline phosphatase activity and rate of gain. There was not a consistent, significant relationship between acid phosphatase activity and rate of gain or between alkaline phosphatase activity and rate of gain of bulls. There were breed, line, and sex effects observed for both acid and alkaline phosphatase activity. Alkaline phosphatase activity was higher in 2-year-old cows than in older ones. Acid phosphatase activity did not show a change with age of cow. Serum inorganic phosphate activity did not show a change with age of cow. Serum inorganic phosphate levels showed a peak at 3 months of age after which they declined with age of the animal (Alexander, Bogart, and Krueger, 1958; Alexander, 1958, 1959).

Paper Chromatographic Studies

Some preliminary studies with urine using paper chromatography have indicated that poor-doing calves excrete at least one amino acid which is not excreted by good-doing calves.

Asplund, et al., (1955, 1956) have found one spot in normal animals which was absent in the dwarf. It was thought that the carrier might also lack this spot and could be identified by this method. However, it has been found that the difference between homozygous and heterozygous normal animals is quantitative in chromatographic expression rather than qualitative. This does not exclude the possibility of using metabolic studies of this nature, but it will require an analytical procedure rather than paper chromatography.

Use of Small Laboratory Animals for Basic Studies

Small animals have been used at some of the stations for the development and testing of basic concepts, principles, and methods in animal breeding which can some day be applied to the improvement of beef cattle. Also, small animals may be used for assay of biological materials obtained from beef cattle.

Some very important results were obtained when all possible crosses were made among 4 inbred strains of mice. In one strain cross it was almost impossible to raise any young, although fertility was about normal. One of the strains apparently had a high requirement for some of the vitamins (biotin and/or folic acid) in the B complex but was low in thyroid function so this strain produced young satisfactorily. Another strain was hyperthyroid but had a low requirement for these vitamins. Crossbreds of these two strains inherited the high requirement plus the high metabolic rate which created a need that was not normally met. By injecting the mothers of these crossbreds or the young crossbreds themselves with biotin and folic acid, it was possible to relieve all deficiency symptoms and obtain normal growth and survival. It was established by this investigation that inheritance, nutrition and endocrines are interrelated in their effects on growth and well being of the animal (Mason, Bogart, and Krueger, 1956, 1956, 1956, and 1959). These interrelations surely raise a question about the value of bulls for use under range conditions when these bulls have been raised and selected under highly desirable conditions. These studies also show that when physiological disturbances develop as a result of crossing, negative heterosis will be the consequence rather than the heterotic effect generally expected from crossbreeding.

Physiology of Circulation and Respiration

Heart function has been studied from electrocardiograms taken on normal calves at 500 and 800 pounds body weight, on calves suffering from white muscle disease, and on various representatives of the dwarf complex using several combinations of leads. Concurrent with the electrocardiograms, heart sounds have been recorded. There are line and sex effects discernible in the normal group at both 500 and 800 pounds body weight.

One of the major contributions in this study has been the development of the proper leads for taking EKG recordings. Also, the analysis of normal records for establishment of normal values with which deviations may be compared has been necessary (Van Arsdel, 1959; Manning, 1959). In all cases in which complete electrocardiographic studies have been made on abnormal animals that were later autopsied, the proper diagnosis by use of the EKG records had been made as revealed by autopsy records (Van Arsdel, et al., 1957). It appears that this method of assessing heart function has great possibilities. It also is evident from the data so

far that abnormalities in heart function occur at a reasonably high frequency in cattle and that these abnormalities in heart function are in some cases responsible for poor performance or sudden and otherwise unexplained deaths that occur.

Higher heart rates and body temperatures of young growing cattle are associated with more rapid rates of gains (Williams, Krueger, and Bogart, 1953, 1954). It appears that rapid growth is associated with a slight elevation in metabolic rate which results in increases in heart rate and in body temperature. There is also the possibility that in selecting for rapidly gaining cattle, there has been a selection of rapidly gaining striated muscle but not of rapidly gaining heart muscle. This may have led to a rapid heart with a relatively long systolic period and a relatively short diastolic period. The latter suggest approaching a duration inadequate for circulation of cardiac tissues. This may lead to the necessity for selecting for larger hearts commensurate with increases in other muscle tissue.

Blood Groups in Beef Cattle

The blood groups in beef cattle have been studied by Stroble, et al., (1954), Stroble and Milston (1955), and Stroble and Glenn (1955). There are blood group differences among lines. Performance data, particularly rate of gain, were studied in relation to blood groups to see if there were demonstrable correlations. This study has not located any relationship between blood groups and performance.

Inheritance of the Tendency for Chronic Bloating

Chronic bloating has occurred each year in 2 to 4 percent of the calves on feed test given a pelleted ration composed of 2 parts half-inch cut alfalfa hay to 1 part concentrate. Bloating bulls have been mated to bloating females and to their very close relatives such as dam, full sister or daughter. Bloating was much more frequent in the offspring produced from these matings (about 50 to 60 percent) (Bogart, 1959).

Digestibility of Feed in Relation to Rate and Efficiency of Gains

It would appear logical that if animals vary in their abilities to digest feed, these variations should be reflected in variations in rate and efficiency of gains. Digestion coefficients have been determined by fecal collections in a digestion stall, by chromogen fecal and feed ratios from grab samples, and by feeding chromic oxide and making fecal and feed ratio determinations of it. No relationship has been established between digestibility coefficients and rate or efficiency of gains (Nelms, Bogart, and Oldfield, 1954; Nelms, Price, and Bogart, 1955). It should be pointed out that all methods for determining digestibility of feed are inaccurate. The failure to demonstrate a relationship between digestibility and rate

or efficiency of gains does not demonstrate that no relationship exists, but that this relationship, if it exists, cannot be established without more refined techniques for determining digestibility.

Physiology of Reproduction

Every project leader recognizes the importance of fertility because of its economic value and also because it influences the amount of selection that can be applied for other traits. Generally, heritability estimates of fertility are low. Brown et al., (1953) have found zero repeatability and heritability for calving interval. Differences between years and sequence of birth were significant. However, evidence points to the importance of other types of inheritance affecting fertility. The work at the Arizona station has shown that dwarf cattle not only have a high mortality rate, but they are below normal in fertility.

Double cervix has been reported at the California station, and vaginal and uterine prolapse have been reported by Woodward and Quesenberry (1956). These are inherited traits that interfere with reproduction. Woodward and Clark (1959) have found a higher number of male than female stillbirths and larger size of stillborn calves. Inbreds and those presented posteriorly showed a higher percentage of stillbirths.

The California station has made extensive studies on sex-limited sterility in cattle. Female sterility is characterized by apparently normal estrous cycles and fertilization, but zygote loss either in the late cleavage or early blastula stages. This is inherited as an autosomal recessive as shown by results of Gregory et al., (1951) and Kidwell et al (1954). Male sterility is characterized by low concentration of sperm in the semen and a high percentage of abnormally formed sperm among those present. Fertility level varies from less than one percent to an upper limit of 30 percent. This type of sterility is also due to an autosomal recessive but is a different gene from the one causing female sterility. Gestation length (Rollins et al., 1956) is shorter for first and second than for later calves. There is no evidence that inbreeding of calf influences length of gestation but inbreeding of dam does increase gestation length. Phenotypic variance of gestation length was estimated at 30 percent due to additive genetic differences between calves, 31 percent due to additive differences between dams, and 39 percent unaccountable.

Harris et al., (1958) have shown that inbreeding reduces breeding soundness in yearling Hereford bulls. Approximately 34 percent of the inbred bulls were either questionable or unsatisfactory in fertility as shown by semen produced or willingness to serve. Linecross bulls showed 18 percent questionable or unsatisfactory.

The work of Cupps, et al., on project W-49 contributes to our understanding of causes of infertility in cows. They have made histological studies of pituitaries, adrenals, ovaries, and uteri of cows exhibiting different

types of reproductive failures. Their study permits a classification of infertility types. This groundwork will be extremely valuable in studies of inheritance of reproductive failures.

Dr. Stratton - Discussion Leader:

(No comments).

Deleterious Characteristics

O. F. Pahnish

Deleterious characteristics in beef cattle are those hereditary deviations from normal which reduce longevity or otherwise impair the productivity of beef animals. It is the primary purpose of this report to summarize work on these deleterious characteristics reported by agricultural experiment stations in the Western Region from about 1949 through 1958. Although a preponderance of this published material appeared in print during the period specified, some reports (directly related to beef cattle) appeared in the literature prior to 1949, and additional reports have appeared in print subsequent to 1958. Additional data are now being organized in manuscript form. This earlier and later work, believed to be of material importance and interest, also is cited.

Since this summary is designed to reflect the scope of the research done in the Western Region, work performed on the same subject matter in other localities is not mentioned. This should not be construed as failure to recognize or an attempt to minimize the importance of the good work that has been accomplished by other research people and other agricultural experiment stations.

In the ensuing paragraphs, evidence bearing on the hereditary nature of the following deleterious characteristics is cited:

- Susceptibility to cancer eye
- Susceptibility to bloat
- Semi-hairlessness
- Vaginal and uterine prolapse
- Stillbirth
- A spastic condition
- Hydrocephalus
- A wry condition
- Dwarfism

Cancer eye

Long-term studies conducted at California (Guilbert, Wahid, Wagnon, and Gregory, 1948), New Mexico (Knox, 1950), and the U. S. Range Livestock Experiment Station, Miles City, Montana (Woodward and Knapp, 1950) have provided information concerning the incidence of cancer eye and some of the factors influencing susceptibility to this condition.

It was learned that four percent or more of the Hereford cows observed developed the abnormality sometime during their lifetimes. The incidence increased with age. Pigmentation of the eyelids tended to reduce susceptibility, but differences in susceptibility were also noted among animals that did not possess this pigmentation. Furthermore, a tendency for cancer eye to appear in descendants of afflicted animals was noted, and line differences in the incidence of the abnormality were noted at the Miles City station. Because of the line differences noted or the observed incidence of cancer eye among close relatives, it was concluded that the susceptibility to this condition is partially under genetic control.

Bloat

Bloat has long been a major concern of livestock producers and feed-lot operators. For this reason, a citation of reports suggesting hereditary differences in susceptibility to bloat is deemed appropriate at this time, even though these reports date back to 1943. Miles City workers (Clark, Knapp, Baker, and Quesenberry, 1943) (Knapp, Baker, and Phillips, 1943) observed rather marked contrasts in the incidence of bloat among the steer progeny of different sires when these steers were placed on postweaning feed-lot performance tests. Such observations suggest an hereditary involvement, at least in part. That environmental factors can also contribute to the incidence of bloat has been generally accepted.

Semi-hairlessness

California workers (Kidwell and Guilbert, 1950) described a semi-hairless condition observed in a Polled Hereford herd. This nonlethal condition was characterized by a deficiency of hair, a thick hide, poor fattening ability, and slow growth. A pedigree analysis of the herd indicated that a single autosomal recessive gene was responsible. The condition was believed to be a recurrence of a condition reported by workers elsewhere at an earlier date.

Vaginal and Uterine Prolapse

It was determined at the Miles City station (Woodward and Quesenberry, 1956) that the yearly incidence of vaginal and uterine prolapse varied from zero to 2.7 percent over a period of about 20 years. Significant differences in the incidence of these disorders among the eleven lines of cattle investigated was considered evidence of an hereditary susceptibility. On the basis of this evidence, it was reported that culling should control vaginal and uterine prolapse to some degree. It was noted, however, that plane of nutrition or specific nutritional differences also may be influential factors.

Stillbirths

It was determined that, over a period of approximately 20 years at the Miles City station, 3.6 percent of all calves born were dead at birth (Woodward and Clark, 1959). No major causative factor was apparent, but it was learned that the mortality at birth was higher in the male calf population than the female, that the incidence of stillbirths increased somewhat with inbreeding, and that twin births were associated with this early mortality. Such evidence points to genetic involvements, at least to some degree. It was also found that first-calf heifers produced a greater proportion of stillborn calves than did older cows and that posterior presentations contributed to stillbirths.

A Spastic Condition

A spastic condition of a lethal nature was reported by the Colorado station (Stonaker, 1958). Evidence that this condition was of genetic origin was presented. This abnormal condition, observed in a few Hereford calves at birth, was considered to be the most serious lethal found by the Colorado workers in a study of inbred stock.

Hydrocephalus

An internal hydrocephalus characterized by a fluid accumulation in the third and lateral ventricles of the brain was studied by Oregon workers (Krueger, Kaufmes, Bogart, Allen, and Vawter, 1955). This condition was observed in stillborn calves and in calves that died within one week after birth. The Oregon workers suggested that hydrocephalus may be a manifestation of the hereditary dwarfism that has been of concern to beef cattle producers in recent years. California workers also observed a rather high incidence of hydrocephalus in dwarf calves. In addition, a study of dwarfism at the Arizona station (Pahnish, Stanley, Safley, and Roubicek, 1955) revealed that hydrocephalus was present in some dwarfs but not in all, and that the same condition sometimes occurred in calves that apparently were not dwarfs. That hydrocephalus may occur independent of dwarfism was suggested by the latter observation.

The causes of hydrocephalus and the relationships of this abnormality to dwarfism, stillbirths, and early postnatal mortality must be determined by additional investigations.

A Wry Condition

California workers (Gregory, 1954) reported two "wry types" in beef calves. One of these abnormal types was observed in the Angus and Hereford breeds. The description of this condition resembled that of one of the dwarf types to be discussed later, and the mode of inheritance was postulated. The other wry type, observed in Hereford cattle only, manifested no dwarf characteristics. This type was characterized by a crooked spine, crooked

forelegs, and enlarged knee joints. It was reported that a wry neck and cleft palate may be present. The investigators believed that this second wry type was the result of faulty nutrition of the dam at some critical point during the gestation period.

Dwarfism

The frequent appearance of dwarf calves in beef cattle herds and the resultant concern manifested by beef cattle breeders have prompted rather extensive investigations of dwarfism since 1948.

In their studies of compressed Herefords, investigators at the Colorado station (Stonaker, 1954)(Stonaker, 1958) found that about 25 percent of the progeny of compressed $\times$ compressed matings exhibited a form of dwarfism. The dwarfism resulting from such matings differed from other forms to be discussed later in that the forelegs were often bowed and the extrusions found on the vertebrae of other dwarf types were absent. The Colorado workers presented evidence that a single incompletely dominant gene was responsible for this particular dwarf type.

A form of dwarfism commonly labeled the "short-headed type" is generally considered to be the most common form produced by the beef breeds. Research undertaken in the Western Region in 1948 or soon thereafter was devoted largely to the description, cause, and control of this dwarf type.

Phenotypic manifestations of the "short-headed" form of dwarfism were described by research workers in California (Gregory, Rollins, Pattengale, and Carroll, 1951), Washington (Lindley, 1951), and Arizona (Pahnish, Stanley, Safley, and Roubicek, 1955). Arizona studies indicated that this form of dwarfism was most commonly manifested at time of birth by a protrusion of the eyes, a continuous protrusion of the tongue, muscular weakness, lack of coordination, and a shortening of the cannon bones in the forelegs. California, Washington, and Arizona workers generally agreed that this form of dwarfism (at a somewhat later stage of development) was characterized by a short, wide head, a prominent midforehead region, an undershot jaw, an enlarged abdomen, labored respiration, slow growth, susceptibility to bloat, and high mortality.

Investigations of the cause of the "short-headed" form of dwarfism at California (Gregory, Roubicek, Carroll, Stratton, and Hilston, 1953) and Arizona (Pahnish, Stanley, and Safley, 1955)(Pahnish, Stanley, Safley, and Roubicek, 1955) indicated that a single autosomal recessive gene was basically responsible. Although these initial investigations were confined to the Hereford breed, California workers (Gregory and Carroll, 1956) soon presented evidence indicating that the same deleterious gene was present in the Angus breed.

When published evidence indicated the hereditary nature of the "short-headed" form of dwarfism, control methods were considered. The Nevada station

(Kidwell, 1951) outlined methods of calculating the probabilities of detecting the dwarf gene in beef bulls by progeny test, and Arizona workers (Pahnish, Stanley, Safley, and Roubicek, 1955) outlined alternative methods by which livestock breeders could engage in a progeny testing program. It should be emphasized, however, that the other stations in the Western Region also outlined appropriate procedures and disseminated the necessary information to livestock breeders through the various experiment station and extension media available to them.

In those phases of the dwarf research program just described, workers at the Washington (Lindley, 1951), California (Gregory, Rollins, Pattengale, and Carroll, 1951), and Arizona (Pahnish, Stanley, and Safley, 1955) stations learned that dwarf animals could be used in breeding investigations and thus could provide a reasonably direct means of obtaining information in subsequent investigations of dwarfism. High mortality, difficult parturitions, small stature, and abnormalities in physical conformation were the major deterring factors.

As dwarf research progressed, California workers noted considerable variation in the phenotypic manifestations of dwarfism. These workers are still engaged in the classification of dwarf types and in investigations to determine the true genetic relationships among them. The California workers (Gregory, 1955) found evidence that at least four dwarf types were conditioned by the same recessive gene, while additional genes apparently were responsible for the phenotypic modifications observed.

The control of dwarfism is hampered not only by the limited knowledge of genetic relationships among the various dwarf types but also by the inability of breeders and research workers to detect breeding animals that appear normal but carry a dwarf-conditioning gene. To alleviate the latter situation much research effort has been and is yet devoted to the search for characteristics that clearly differentiate dwarf from normal and heterozygote or "carrier" from normal (noncarrier).

Results obtained by California workers (Carroll, Gregory, and Rollins, 1951) indicated a deficiency of thyrotropic hormone in the pituitary glands of dwarf calves, although conflicting evidence has been found elsewhere.

A method of recording head profiles for the evaluation of the mid-forehead prominence as a means of detecting heterozygous animals was devised at California (Gregory and Brown, 1952). The California workers (Gregory, Rollins, and Carroll, 1952)(Gregory, Roubicek, Carroll, Stratton, and Hilston, 1953) found the profile to be a reasonably accurate tool for differentiation of bulls in the herds studied, but Colorado (Stonaker, 1954)(Stonaker, 1958) reported less success with the same technique when it was used on Colorado stock. It was, therefore, suspected that head form may be affected by other genetic or environmental factors. In addition, Wyoming (Schoonover and Stratton, 1954) met with little success in an attempt to adapt the profile technique to females.

Colorado (Stonaker, 1958) using x-rays of the lumbar vertebrae reported that some lines of cattle possessed atypical vertebrae, even though there was no evidence that the animals involved were heterozygous. The technique used was devised at Iowa and is currently under investigation at that station.

Urine analyses by paper chromatography are under investigation at the Utah station. Glutamic acid excretion by dwarfs was reported to exceed that of normal animals, and an unidentified spot on certain chromatograms was quantitatively different for heterozygotes and homozygous normal animals (Bennett, 1958). These studies are continuing.

California studies (Cornelius, Tyler, and Gregory, 1956) indicated that the protein, calcium, magnesium, phosphorus, cholesterol, and protein-bound iodine levels of blood serum were within the normal range in dwarf animals.

Cytological studies conducted by California investigators (Leuchtenberger, Schrader, Hughes-Schrader, and Gregory, 1956) revealed that the DNA content of sperm from dwarf bulls showed more than the normal amount of variation. In some instances, the DNA content of sperm nuclei from dwarfs and probable heterozygotes was below normal.

Rather extensive skeletal studies are continuing at the California station. The results of some of these studies are available in published form or have been consolidated for publication (Gregory, 1958)(Julian, Tyler, Hage, and Gregory, 1957)(Tyler, 1957). The long bones of the dwarf skeleton were shortened by dwarfism, with the greatest shortening in those bones farthest from the trunk. A premature closure of the speno-occipital synchondrosis was noted in "short-headed" dwarfs. Partial closure was noted in some dwarfs at birth, and complete closure in all dwarfs by the age of 5-1/2 months was reported. It was stated that closure in normal animals occurs at from 24 to 36 months of age. Recent analyses of metacarpal measurements illustrated the influence of dwarfism upon metacarpal growth and suggested that such measurements may be of considerable value in the diagnosis of dwarfism and in the detection of heterozygotes.

The foregoing review has summarized very briefly the contributions by research workers in the Western Region to the knowledge of deleterious characteristics in beef cattle. Investigations of the problems pointed out by past research are still in progress. There is every indication that the future will bring forth additional information that will be of material value to the beef cattle industry.

Dr. Gregory - Discussion Leader:

Dr. Pahnish has covered this very well. I am going to anticipate some questions and discussions, and I think I will answer them by showing a slide that explains our distributions based on diagnostic criteria we have developed. (Explained slide.) We are getting other points now where we can have means of identifying these different types--not only metacarpals but S-O synchondrosis. Dr. Julian has quite a lot to publish.

Performance Testing and Field Application
J. A. Bennett

Performance testing in cattle involves measuring the ability of the animals to produce. Several factors are involved with and contribute to production. The main factors may be classified as follows: (1) Hardiness (survival and adaptability), (2) Reproductive efficiency (including maternal ability), (3) Gaining ability, (4) Efficiency of feed utilization, and (5) Carcass merit.

Hardiness

To a great extent adaptability influences the other performance factors. An animal must be well adapted to its environment in order to have high merit in the other production factors. Selection for performance to a great extent is selection for a greater degree of adaptability.

Carcass merit is important but since it is to be considered in detail in another report it will not be discussed here. This discussion will be concerned primarily with the three items, viz., reproductive efficiency, gaining ability, and efficiency of feed utilization.

Reproductive Efficiency

Efficient reproduction requires that cows conceive readily, give birth to full-term calves without complications or difficulty, that the calf have sufficient vigor to get a good start in life, and that the cow provide necessary care and nourishment until the calf can fend for himself. Christian (1957) reported age at puberty as 353, 378, and 383 days of age for Angus, Herefords, and Shorthorns, respectively. The Colorado station found that peak fertility occurred in cows at from 4 to 7 years of age, and that bulls under 6 years of age brought about the highest fertility. The calving interval and time interval from parturition to estrus were found to be influenced largely by environmental factors (Brown, et al., 1954, and Warnick, 1955, respectively). The Miles City station found that stillbirths were more frequent with male calves than with female, and that vaginal and uterine prolapse were more common in some lines than others, suggesting genetic influence.

Large cows have an advantage over small cows in calf production. They produce heavier calves at weaning time in addition to calving more regularly, and thus yield more calves on a lifetime basis. This advantage is still apparent when calf production is compared on a basis of 1,000 pounds of cow weight (Blackwell, 1955).

The ability of cows to wean heavy calves is a valuable characteristic. Lindholm and Stonaker (1956) found weaning weight to be one of the most important economic characteristics to be considered in selecting beef cattle. From an analysis of over 4,500 calf records at Miles City, Koch and Clark

(1955) concluded that maternal environment is quite important to birth weight and to gains from birth to weaning. Rollins (1954) concluded from a study of California calves that lactating ability of a cow makes a major contribution to the growth of the calf throughout the entire suckling period.

Growth of calves from birth to weaning is largely a linear function (Arizona, New Mexico, Oregon, Wyoming). Male calves are larger at birth and gain faster than females. Amount of difference due to sex varies from station to station with males having an advantage of from 28 to 40 pounds at approximately 6 to 8 months of age (New Mexico, Arizona, Oregon, Utah).

Age of dam has a marked effect on weaning weight of calves. The heaviest calves are obtained from 7- and 8-year-old cows with only small differences appearing among cows 6 to 9 years of age. Three-year-olds are markedly inferior to the mature cows in this respect with the calves averaging from 39 to 53 pounds lighter.

The time of year that calves are born influences weaning weight. Those born late in the spring apparently are not as well nourished by their dams and growth takes place at a slower rate.

Weaning weight is considered to be of such importance as to warrant strong selection pressure in culling the cow herd. Many stations have computed adjustment factors to aid in increasing the accuracy of appraisal.

Differences in adjustment values have been obtained at the various stations indicating that environmental differences of some magnitude exists between stations. It is evident that no single set of adjustment factors will fit all conditions with sufficient accuracy.

Sex of calf, age of dam, and age of calf at weaning are the main factors that require adjustment. Further adjustment for time of birth may be necessary when calving is distributed over a longer period than 90 days.

Pahnish et al. (1950) found that regression coefficients for weight-for-age differed between male and female calves. It was concluded that it was desirable to use separate adjustments for each sex. This station also found that age of dam exerted a greater influence upon weaning weight of bull calves than that of heifers, again suggesting the desirability of separate adjustment factors. Research workers at New Mexico concluded that multiplicative correction factors for age of dam give greater accuracy than additive factors.

Gaining Ability and Efficiency of Feed Utilization

At the time of initiation of the W-1 project, considerable information was already available concerning testing cattle for the ability to gain and to utilize feed efficiently. Knapp et al., (1941) found that birth weight had very low predictive value for determining pre- and post-weaning gains in the feed lot. Weaning weight also was known to have only low correlation

with future gains (Black and Knapp, 1936). It had been demonstrated by several tests that it was not possible to detect differences in gaining ability by visual appraisal. Black and Knapp (1936) had shown, however, that a postweaning feed-lot test did detect differences in gaining ability and would show differences between sires. Knapp and Nordskog (1946) had reported rather high heritability levels for rate and efficiency of gain based on a postweaning feed-lot test.

Work under the W-1 project concerning gaining ability can be grouped into two main categories, first, the use of gain tests as an aid to producing improved lines of cattle and, secondly, studies to simplify or to increase the accuracy of the method of measuring gaining ability. The latter involve detailed studies of those factors that might influence gains on test.

Testing Procedures

Feed-lot testing for rate of gain is practiced with all experimental herds in W-1. Individual feeding is common for the bull calves and some heifer and steer calves although group feeding also is practiced with heifers and steers. Time-constant test periods of 140 and 168 days' duration are used as well as weight-constant tests of from 500 to 800 pounds by some stations. It has been shown that the correlations between these three types of tests are high, particularly for rate of gain. Growth during this period is largely linear (Oregon) which would explain the close agreement.

Length of the adjustment period between weaning and start of the feed test varies from station to station. Montana has shown differences between lines in the ability to adjust to the change in environment, thus suggesting the need to allow sufficient time for adequate adjustment.

Work of the California station suggests that the period immediately following weaning is more accurate for measuring genetic differences in rate of gain than is a period that starts several months after weaning.

Rations of various types have been tested for feed-lot gain measurement. Idaho tested different ratios of concentrates to roughage that ranged from three concentrates to one roughage, to one concentrate to three roughage, and found that steer calves made the most rapid gains on a ratio of two concentrates to one hay. Oregon found that a ratio composed of one concentrate to two parts roughage enabled genetic differences in gaining ability to be expressed. This definitely showed that it is not necessary to feed-test animals to a high degree of finish to measure inherent gaining ability.

All-pelleted rations have been tested. Oregon has obtained satisfactory results with such rations, but variable results have been obtained at Idaho, Washington, Wyoming, and Utah. Occasional bloating and other serious digestive disturbances have occurred at these stations with cattle on all-pelleted rations. The size of the hay particules in the pellet plays an important part but apparently is not the whole contributing factor.

Results on Test

Differences in rate and efficiency of gains have been observed at all stations. It is usual to find about one pound difference in daily rate of gain between the highest- and lowest-gaining individuals of the same sex. Sire and sex influence upon rate and efficiency of gains have been particularly strong. Since heritability of rate of gain is high, it is not essential to have progeny tests and, in general, emphasis has been placed on individual gains. Frequently, however, all the offspring of several sires have been tested for gains and have provided progeny test information.

Bull calves regularly have gained faster than steer calves, and steer calves faster than heifer calves, on the feed-lot tests. The magnitude of the difference between bull and heifer calves in average daily gain has been from 0.5 to 0.66 pound in most cases.

Type and size in relation to rate and efficiency of gain has been investigated in detail at Colorado, Montana, New Mexico, and Wyoming. It is virtually impossible to separate type and size for investigation purposes in beef cattle. Large animals have been found to gain faster and to be heavier at all ages. Small-type animals attain market finish at a lighter weight. In gross efficiency, large-type animals have an advantage, but if the tests are terminated at an equal degree of finish for both types, no difference in feed efficiency is apparent. One point of great interest observed in the type studies is that individual differences in gaining ability are present among animals of similar type. This is of importance because it indicates that improvement likely can be made within any given type.

A multitude of body measurements have been made in an effort to find some that would have high predictive value for rate and efficiency of gains. It has been demonstrated that some measurements are related to gaining ability but the relationship is not sufficiently high to be very useful. In general, those measurements that indicate capacity, such as length of body and circumference of heart and paunch, show the higher relationships. At this stage it cannot be concluded that body measurements cannot be useful for predictive purposes. Refinements in measurements and/or alteration in time of measurement may give better results.

Initial weight on test and age of dam do not have a highly pronounced influence on rate of gain. Colorado found that both initial weight and age of dam influenced rate of gain, while New Mexico and Utah observed that initial weight did not have an influence on gain. There is then a definite possibility that weight on test may have a greater influence under certain testing conditions.

Rate of gain and efficiency of gain have been found to be highly related. Gross efficiency is significantly related and the correlation is much higher when body size is standardized. Efficiency is strongly influenced by size.

Animals at lighter weights are more efficient than they are at heavier weights. The decline in efficiency with advancing weight is very marked. It is evident from this that comparisons between animals must be made at equal weights. This can be accomplished by testing through a weight-constant period or adjusting the data to a constant weight. Oregon results show that bull calves decreased in efficiency faster than heifers but continued to be more efficient at 800 pounds weight.

It has regularly been found that heifers are not as efficient as bulls. In most cases, the heifers have required from 20 to 25 percent more feed for each unit of gain. The cause of this difference in efficiency associated with sex is not fully known but there may be an appreciable difference in the composition of tissue. Heifers tend to fatten earlier than bulls and usually have scored higher in condition at the conclusion of the gain tests. Each pound of weight gain in heifers generally represents more stored energy than a pound gain in bulls and we could not then expect heifers to be as efficient in feed utilization if efficiency is measured in body weight increase in relation to feed consumed.

Differences in condition at the beginning and end of performance test influence the measure of efficiency. Refined measures of efficiency must take such differences into account. Techniques to measure these differences in live animals have been explored in detail in the Western Region. Body measurements, antipyrine, N-acetyl-4 aminoantipyrine, tritium, and ultrasonic sounding have been shown to be of some value for estimating condition in live cattle. Tritium has given greater accuracy than the antipyrine substances and body measurements, but an exact technique as well as expensive equipment is required. Ultrasonic sounding has shown some promise but further adaption of the method is needed before it can be applied widely under field conditions. There is still need for a simple yet accurate method that can be applied in the field.

Field Application

From a rather slow beginning when the new ideas of performance testing were looked upon with considerable skepticism by purebred and commercial breeders, performance testing has grown in popularity until it is now widely used as a selection aid. A recent survey shows that in the western states 746 herds involving over 71,000 animals are participating in performance-testing programs. Numbers in such programs are increasing rapidly. This successful promotion of performance has resulted from a strong effort and a combined effort of research and extension personnel.

Research under W-1 has done much to contribute to successful performance testing in the field. In the first place, results of studies have shown that performance testing is a sound method of cattle improvement. Secondly, the results of the research have been publicized. Some 603 publications of technical and semi-technical nature have been released. In addition, hundreds of popular-type articles have been written and unnumbered talks given by state, regional, and national personnel based on the results of research in W-1.

Some of the findings in research that have helped to promote performance testing in the field are as follows:

1. Genetic factors are contributing in a large way to differences in performance levels among cattle. Heritability levels that have been calculated periodically uniformly have indicated high levels for factors associated with gain. The Miles City station as well as the Montana station have shown that steer progeny of high-scoring, performance-tested bulls gain faster and are more profitable in the feed lot than progeny from unproven bulls. Oregon has shown that the gaining ability of a herd improved markedly in only one generation of selection on the basis of performance.
2. Variation in performance ability exists among animals of the same type. Many stations have shown this to be true and it indicates that good-doing animals can be obtained without seriously sacrificing beef type.
3. Rate and efficiency of gain are highly related. This makes possible on-the-farm testing for gaining ability to be carried on under conditions where individual feeding is not practicable with considerable assurance that efficiency is not seriously neglected.
4. Weaning weight of calves has a high economic value and should be stressed in selection. This finding indicates the desirability of extending performance tests to the cow herds including commercial herds.

The types of programs instituted in the several western states have been varied. In many states, central testing stations have been set up for gain-testing bulls. Some stations, such as Miles City, Colorado, and California, have put bulls out in cooperators' herds for comparison. The Montana station, as part of its project, compares steers sired by performance-tested bulls and from lines and line-crosses with random-selected steers from untested cooperators' herds. The Hawaiian station project has been unique in that it has used cooperators' cattle almost entirely. The cooperators by observing and taking part in the research have seen the merits of selection on performance and have attempted to make use of it on a larger scale.

All of these activities have done much to promote performance testing and have been highly useful to extension workers in applying the procedure in the field. W-1 is not yet 12 years old, and beef cattle experiments yield results more slowly than most other farm animals; yet, a vigorous, sound performance-testing program is under way in privately-owned herds in nearly every western state.

Dr. Holland - Discussion Leader:

The only comments I would like to add would be on application of performance testing. It might work in the field with the people whose interest is limited, but a lot of people who are interested in ROP have been oversold. It is not only our job to interest people in ROP but to point out its limitations. We can show how much progress can be made--this is not going to be as great as a lot of people think it is going to be.

Dr. Stonaker:

Some of these data coming in indicate increases of 50 pounds weaning weight with appreciable numbers of cattle involved.

Dr. Holland:

I would rather believe the experimental work, and I cannot believe they could go up that much.

Mr. Sawyer:

It is difficult to separate management improvement from genetic improvement.

Dr. Holland:

A lot of improvement is because a man going into it pays more attention to management details.

Carcass Appraisal and Literature Review
P. O. Stratton

The efforts of beef cattle research workers of the Western Region in the field of meats may be categorized as follows: First, a study of the association of records of performance, growth, size, and breed to carcass merit, and, Second, the development of techniques to predict carcass merit from live measurements.

In the studies of the first category, the preslaughter data include periodic growth measurements by weight and linear measurements of body size. In general, most of the desirable preslaughter and postslaughter characteristics were positively correlated. Length of body appears to be an asset to carcass merit, a fact contrary to previous belief. Very generally, it has been found in all studies that much of the observed positive correlation among various body measurements arises from their relation to general size. This appears to be true for the relations between the body measurements and carcass traits. Animals with a greater proportion of the forequarter are less efficient animals.

It was found that differences in weaning weight had no apparent effect upon the carcass appraisals that followed a 250-day feeding period. Also, birth weight had no effect on carcass quality. Therefore, it appears possible to select for heavier birth and weaning weights without sacrificing fleshing qualities.

The Oregon, California, and Nevada stations have reported little or no difference in carcass cutout values between breeds or crossbreds. Likewise, Colorado found very little difference in the percentage of the major cuts in the carcasses of conventional type vs. comprest type steers within breed. The bone-lean-fat ratio of the 9-10-11 rib cuts showed almost identical composition for the two types.

The record-of-performance steers at the U. S. Range Livestock Experiment Station and the New Mexico Agricultural Experiment Station have been used to determine heritability estimates and correlations of specific carcass characteristics. The magnitude of these heritability estimates indicates that appreciable genetic progress can be made in selecting for a more desirable carcass.

Heritability Estimates

Carcass grade	34	Area of eye muscle	69
Shrink	91	Thickness of fat	32

Correlation studies with these animals have pointed out the relationships of various carcass characteristics with performance and measurement data.

Correlations

Carcass grade with:

Birth weight	-.07	Length of body	+.09
Weaning weight	+.43	Length of leg	+.08
Efficiency of gain	+.03	Gain on test	+.43
Slaughter grade	+.52	Calf grade	+.02
Area of rib eye	+.23	Yearling gain	+.02
Thickness of fat	+.54	Yearling grade	+.11
Dressing percentage	+.45	Fat grade	+.46

Area of eye muscle with:

Final feed-lot weight	+.14	Carcass grade	+.23
Birth weight	+.28	Length of body	+.38
Weaning weight	+.32	Length of leg	+.42
Gain on test	+.36	Thickness of fat	+.01
Efficiency of gain	+.07	Dressing percentage	+.36
Slaughter grade	+.29		

These studies show that live-animal appraisal as feeders is not as accurate in predicting carcass grade or muscling as is feed-lot performance. The positive correlations that are cited indicate that selection for improved feed-lot performance also improves carcass grade and muscling.

Studies of the second category have been emphasized at the Utah and Wyoming stations. In an attempt to improve methods for estimating fat in the live animal, techniques with antipyrine, heavy water, and creatinine levels in blood serum have been studied. The success of the antipyrine method was found to be dependent upon the techniques used in injection of the antipyrine solution and the withdrawals of blood samples as well as the preparation of the reagents necessary for the precipitation procedure of the analysis. Although the correlations between serum creatinine and carcass lean were highly significant, the predictions by serum creatinine for rib-eye area and for lean in the rib cut were low:

$$r^2 = .27 \text{ and } r^2 = .31$$

The use of heavy water or tritium is a relatively new technique, but to date shows more promise than the previous techniques studied.

Wyoming has recently initiated a project in an attempt better to evaluate the relationship of carcass merit from sire to progeny. Semen collected from potential sires on feed test preslaughter is frozen and kept for use after the sires have been slaughtered and their carcasses appraised. Semen from those slaughtered bulls selected for superior carcass merit is used in an artificial insemination program within the cow herd to produce progeny to be slaughtered at a comparable age (14 months) for a direct carcass comparison.

(Dr. Stratton presented Dr. C. B. Roubicek's comments on the Literature Review, since Dr. Roubicek was unable to be present at the W-1 meeting due to a conflict in dates with the Reciprocal Meat Conference.)

I. Station replies to beef cattle literature review report

1. 43 inquiries mailed to all Technical Committeemen (3 regions)
32 replies
11 no answer (including two from W-1)
2. All replies were in favor of completing the review except one (Hawaii) which had a question about it.

II. Summary of general comments on replies

1. Complete the review.
2. The completed review should be published in a form and in sufficient quantity for general distribution, especially for graduate students and extension workers.
3. In its present form, the review apparently is used by research workers as a quick reference for work in a particular field. It is not intended to be used as a verbatim interpretation of experimental results. If the present form is continued, should an additional scheme of cross references be devised?
4. If the review is to be completed, every effort should be made to have it available for distribution as soon as possible, preferably within a year or eighteen months.

Based on personal experience through correspondence and comments concerning the present literature review, I would add the following:

1. Personnel in foreign countries in areas of work even remotely associated with beef cattle have been eager to get copies of the review.
2. Several teachers of production courses in animal husbandry have requested copies of the review for their students. Since we never had sufficient copies for such distribution, these requests could not be met. However, this is a problem that will have to be faced if the review is going to be published again.
3. Although the review should be limited to beef cattle, it would be worthwhile to include with each section an additional list of references that cover other species. This would be especially applicable for sheep and small animals.

The following are suggested questions that will have to be answered by the W-1 Technical Committee:

1. Should we complete the review? If the answer is "yes", then:
2. Do we still accept the division of responsibility as agreed at the 1956 W-1 Technical Committee meeting?
3. Will the Committee as set up by Dr. Bogart (J. A. Bennett, R. T. Clark, P. O. Stratton, W. C. Rollins, with C. B. Roubicek as Chairman) act as the editorial board, or how will that part be handled?
4. Will publication be through the U. S. Department of Agriculture? Dr. Clark has this information.
5. What is the absolute deadline for completion of contributing sections?
6. Will the Denver office prepare the final manuscript?

Dr. Kincaid:

Regarding the Literature Review, I have heard a good many comments, I have heard a good many people say they have found it very helpful.

Dr. Stratton:

Have they shown enough interest possibly to help contribute, or would it go as a volume to be sold?

Dr. Kincaid:

I expect that it would.

Dr. Clark:

I think it is feasible to publish it in a better form than it was published originally. We are going at it in a different way if it is published again.

Summary of Project to Date
R. T. Clark

General Accomplishments

First, we have learned to work together on a team basis--with all that implies--despite the usual discontinuity of staff which all institutions must face. Through a regional effort we have brought about an even greater exchange of ideas than existed in the past, and annual meetings since the inception of W-1 have accentuated exchanges of information among the cooperating states.

Second, despite the necessary committee approaches we have tried to preserve the freedom of the individual. I am reminded of an article that appeared in McCall's Magazine in May of this year, written by Anne W. Langman, in which she wrote, "Colleges have caught the modern contagion where so often one man's inspiration must be subordinated to the safer compromise of group thinking." Actually, her article dealt with the high mortality rate in college executives at this time.

With reference to specific accomplishments:

1. The literature produced now numbers 628 publications as listed by the state project leaders. That of itself is a large accomplishment by a very small team of research workers.
2. This literature reveals the merits of some of the lines of cattle that have been produced. Some people have maintained through the years that it was up to us to develop methods of breeding rather than lines of cattle, while others have felt that if we could not produce useful stock at the same time, our project would hardly merit major consideration.
3. Increasing interest in artificial insemination in beef cattle has resulted in greater demands on stations for desirable stock. Naturally, the station herds are the ones on which we have the most detailed information from a strictly utilitarian viewpoint, and in which a number of commercial cattlemen put credence. This has already precipitated questions on methods we should employ in the future for dissemination of these stocks to industry. We now find a number of the artificial insemination centers controlling, either by outright purchase or loan agreement, sires that were produced in our station herds.
4. As stations have acquired through the years the numbers of animals necessary to round out their projected research programs, W-1 now controls over 6,500 head of cattle.

5. A number of testing programs have been initiated in the region. These have been aimed at providing better information on the relative combining abilities of specific lines and their performance in top-cross tests. But there is much to be done yet on this phase of the work.

6. Practically every station in the region has been working directly or indirectly to assist the industry in the elimination of deleterious characters in the major breeds. It is hard to evaluate this accomplishment in all of its aspects, but at least we have been able to provide a certain amount of leadership in difficult areas. Those of us who have been close to the work appreciate the cooperation achieved with industry. The work has tended to become more fundamental in nature as we learn more about the problem.

7. Through the facilities of the Denver office in cooperation with the U. S. Air Force a number of stations have stepped ahead in their analysis of data. This cooperative approach has helped to maximize the efforts of our small staff. It has resulted in improved speed of manuscript presentation and a sounder regional effort. Other stations more fortunate or with ready access to facilities for business machine operation have been encouraged to follow this approach. Speeding up analysis has tended to assist us in improved design of experimentation.

8. A number of heritability estimates have been and are constantly being derived by the stations that control sizable populations. With the passage of time, and as generations are produced, we are getting into a new position of being able to evaluate whether some of these estimates are in line with accomplishments measured. Spot-check inspections of some of these data reveal that our progress in certain instances is in line with these heritability estimates.

9. Reflections of some of these estimates are evident from the demand situations that we are now observing in industry. In some of the states premiums are being paid for stocks derived from tested material. In an article in Agricultural Research, April 1959, the statement is made, "When they pocket an extra two to six cents a pound for their certified feeders, as they have done in Montana, even skeptics become firm believers."

The Montana station reported, at a field day of its North Montana Branch at Havre, June 18, some very interesting results. The trial consisted of a comparison between cattle from name herds against experiment station-selected cattle including a control herd of Miles City Line 1 stock. Their results showed a 13 percent over-all advantage in productivity in favor of the station cattle. This, I believe, is possibly the highest recorded advantage in tests of this nature.

If we were able to apply this 13 percent advantage to the total of all cattle marketed in 1958, it would amount to approximately \$700 million. Even if we applied the advantage only to the steers that were fed in 1958, it would be equivalent to approximately \$300 million.

10. Correction factors have been devised based upon the results obtained by a number of stations. These can be used by breeders in determining an animal's probable genetic value and appropriately assessing environmental influences, particularly where the prevailing conditions are somewhat similar to those under which the experimental facts were derived.

11. With reference to the Literature Review which our W-1 group published through the Arizona station, there is nothing that we have accumulated or touched that has received such widespread favorable response, and Dr. Roubicek is to be highly commended for the effort he expended to put this material together in its initial form. I should also like to compliment our own stenographic staff for the care with which this Literature Review was finally prepared, and the Arizona station for the manner in which the assignment was carried forward and the beginning material distributed, even on a limited basis.

12. Without question the W-1 project through the years has stimulated industry people to focus more attention on selection practices of a utilitarian nature. Aside from the research contributions to knowledge that have come from this work, perhaps this stimulation in industry represents a major accomplishment stemming from our regional project. As we have gone along in this effort as a team, we have become fully cognizant of the fact that slowness in terms of years necessary to produce a generation makes it all the more necessary that we perform project work that is well planned and can be continued in the future. During the relatively short term most of us can be associated with efforts of this nature, we are permitted to see only a limited number of generations pass in review before our work must be entrusted into the hands of newcomers.

As I look back through the years that we have been engaged in this effort I am certain that as a "fall-out" of this teamwork we have tended to bring animal science to a higher plane in the entire field of biology, and that aside from research we have stimulated educational programs that will benefit our standing among the fields of learning. For example, in the case of Oregon, Dr. Ralph Bogart and his associates have trained fourteen Ph. D's., and ten Masters. I have felt for some time that the inexpensive phase of our project is closed and we are now engaged in the really costly phases.

Reasons for Continuation of W-1

Administrative Adviser Wheeler and Director Price suggested that it would be appropriate to present cogent reasons for the continuance of this regional project.

In line with that suggestion, here are a few phases of the total effort that warrant further investigation or initiation when feasible, and they are given not necessarily in order of importance:

1. Continue the development of selected lines of beef cattle within the established breeds, for up to now we have been able to make only a very modest yet creditable showing under this primary objective.
2. Continue our studies of selection criteria and breeding techniques, for in the time consumed so far only a few generations have passed in review. It is necessary to learn more about genetic, endocrine, and environmental effects as they influence variation in performance.
3. Continue to a logical conclusion and publication of results the current studies on deleterious characteristics and methods for their control.
4. Complete currently planned crossbreeding trials going on at several locations in the region.
5. Expand our testing of combining abilities of lines, and devise methods for early testing.
6. Initiate studies on physiological differences, particularly with the objective of being able to make effective selections early in life.
7. Initiate adaptation studies including introduction of new material from other parts of the world so that animal breeders may enjoy the same freedom that plant breeders have exercised for many years.
8. Initiate additional studies to devise accurate methods for determining components of growth and efficiency of feed conversion. Knowing the true composition of the live animal would be an extremely useful tool in selection.
9. Develop more accurate measures of carcass appraisal that will reflect properly the nutrient values.

The Committee expresses sincere appreciation to the Directors of the region in supporting this field of agricultural research and helping to develop a sound example of regional research, which was recognized in the encouraging statement on W-1 which the Committee of Mine issued in February 1958 when they reviewed our work.

Dr. Bogart:

I would like to express the very great appreciation of the Committee to the Directors for the time you have spent with us and seeing some of the results first-hand. Also, I would like to express my appreciation to all the people who have made contributions in the reports they have given in the panel discussions.

The meeting adjourned.

Business Meeting

July 9, 1959

Dr. Cobb presented a revision of the Hawaii project (which had been circulated to the Committee prior to the meeting). Dr. Bennett moved it be accepted. Mr. Willson seconded. Motion carried.

Dr. Pahnish presented a revision of the Arizona project. Dr. Stratton moved it be accepted. Dr. Cobb seconded. Motion carried.

Dr. O'Mary withdrew the revision of the Washington project last presented, as Dr. Hafez is now a member of the staff and it was felt he should have an opportunity to consider the revision before it was presented for Committee acceptance.

Professor Willson then introduced the subject of whether the supplement to the recurrent selection phase that he circulated to the Committee required formal acceptance. This was discussed, and in keeping with the comments of Dr. Burris, Dr. Cassard moved the addendum to the Montana project be accepted. Dr. O'Mary seconded. In the subsequent discussion of the motion, Dr. Stratton said if it is added as an objective then the Committee must act on it. But it is not a complete deviation from what the Montana station has been doing. Drs. Cassard and O'Mary withdrew their motion. It was the considered opinion of the Technical Committee that this modification was sound.

Dr. Bogart:

We will move on to the next thing--confirmation of the next Chairman of the Technical Committee, which, according to our way of operating, will be a representative from the Utah station.

Dr. Stonaker:

I so move.

Professor Willson:

Second. (Motion carried unanimously).

Dr. Stonaker:

I think it should be alphabetical, including US (U. S. Range Livestock Experiment Station) as well as Utah.

Dr. Bogart:

If we are going to go in order by station, it will have to be the U. S. Range Station.

Dr. Woodward:

So long as Mr. Quesneberry isn't here, why not let it stand. He is the Committee member.

Dr. Warwick:

Mr. Quesenberry was made officially a member of the W-1 Technical Committee as a representative of the project, so he is probably eligible. It is up to the Technical Committee.

Dr. Stonaker:

Is there a possibility that in letting it ride there might be an advantage if the group considers the possibility that we might get an invitation from Utah to come to their station since the Western Section meetings will be there? It might be well to have the Chairman there. It will be entered in the minutes that we consider the Technical Committee member from the Range Station as Chairman for next year.

Dr. Bogart:

The next thing is when and where we will meet.

Dr. Bennett:

I would like to invite the Technical Committee to meet at Utah next year.

Dr. Cobb:

I move we meet at Utah next year.

Dr. Christian:

I second the motion. (Motion carried).

Dr. Bogart:

Which would you prefer, before or after the Western Section meetings?

(There followed a discussion of the various alternatives, keeping in mind various sectional and national meetings).

Dr. Bogart:

Would anyone care to make a motion that we leave it to the Executive Committee?

(A motion was made, seconded, and carried that the Executive Committee decide on the time of the meeting.)

Dr. Bogart:

Is there any other business?

Dr. Stratton:

The calving percentage of two-year-olds is variable, and I wonder if we should not in our production reports by station show percentage calving by two-year-olds separately.

Dr. Bogart:

I think that is a good suggestion.

Dr. Clark:

I would say the more informative you are in the material you report the better off we all are.

Dr. Bogart:

Are there any other matters of business?

Dr. Stratton:

The matter of the Literature Review.

Dr. Bogart:

That is also a committee report. Dr. Stratton, would you report on the Literature Review and Publications Committee in the absence of Dr. Roubicek? (Committee: Dr. C. B. Roubicek, Chairman, Dr. J. A. Bennett, Dr. R. T. Clark, Dr. W. C. Rollins, and Dr. P. O. Stratton.)

Dr. Stratton:

I reported last night what Carl's suggestion had been. But in addition, these questions Carl asked should be decided on in our Committee meeting. Should we complete the Review? Possibly some discussion from the floor is in order.

Dr. Cobb:

Bring it up to date, or are there other categories that have not been covered?

Dr. Bogart:

Both.

Dr. Rollins:

I think this is certainly good to have the review of literature, but how much duplication is there here with Animal Breeding Abstracts in terms of the amount of work that has to go into the review? Should we take that into consideration?

(Dr. Clark then read a laudatory letter on the Literature Review which he had received from Dr. H. P. Donald of the Animal Breeding Research Organization at Edinburgh.)

Dr. Stonaker:

I think Wade has a good point. I don't know, but it just seems so many assignments just don't get done any more. Is Animal Breeding Abstracts doing an adequate job for us?

Dr. Christian:

They do pretty well, but if you want to find a particular subject you have a hard time looking it up.

Dr. Bogart:

You have to go through all Animal Breeding Abstracts to find it all.

Dr. Clark:

We are basing our ideas on what has come to us from people who have used it. The revision of the section Carl has I have seen in the rough. He has done a very painstaking job on his section.

Dr. Holland:

I am new as a Technical Committee member, but I am concerned on my project as to what happens on the financing. Is this being done by the Arizona station? If so, I don't see where we have much to discuss. It is a fine thing. The only thing I see is the money.

Dr. Bogart:

The idea is not that this would be done by the Arizona station alone. It would be done by the members.

(Further discussion took place on ways and means and advisability of proceeding with further revisions of the Review.)

Dr. Bogart:

What is the will of the group?

Dr. Bennett:

I personally feel that the Literature Reviews that were put out were extremely useful, but keeping them up to date is a lot of work. If they could be kept up at some central place by means of abstracts it would be wonderful. Why don't we explore the possibility and see what could be done?

Dr. Bogart:

Why not set the thing up with the committee to look into it?

Dr. Stratton:

Could we be assured of cooperation from the other members if we make a decision?

Dr. Bogart:

It has been moved by Dr. Bennett and seconded by Dr. Pahnish that we leave to the Committee on Literature Review and Publications the exploring of the possibility of using abstracts which can be handled in the Denver office for taking care of bringing the Literature Review up to date.

(Motion carried unanimously.)

Dr. Bogart:

We will hear from Dr. Pahnish, Chairman of the Committee on Resolutions.

(Dr. Pahnish presented four resolutions):

BE IT RESOLVED, That the W-1 Technical Committee express appreciation to Oregon State College for the excellent facilities made available for the 1959 meeting and for the fine hospitality accorded. An expression of gratitude is extended particularly to the members of the Animal Husbandry Department, their wives, and the graduate students who generously devoted their time and efforts to the preparation for the 1959 meeting, and who so graciously extended their hospitality to the members of the Technical Committee and their families.

BE IT RESOLVED, That the W-1 Technical Committee extend thanks to Dr. Hugo Krueger and to Dr. Ralph Bogart who personally sponsored the salmon barbecue on the evening of July 8, 1959, and that Professor A. W. Oliver be complimented highly for his excellent preparation of the salmon.

BE IT RESOLVED, That the W-1 Technical Committee express its appreciation to the Experiment Station Directors of the Western Region for their support of the W-1 Program since its inception, and for their continuing interest in this program as manifested by their attendance at the sessions of the annual meeting held during the afternoon and evening of July 8, 1959. The Technical Committee welcomed the opportunity to review for the Directors the accomplishments over the past ten years and to present the areas of research that should receive emphasis in the future.

BE IT RESOLVED, That Dr. C. E. Shelby be commended for his competent assistance and leadership during Dr. Clark's leave of absence and that the Committee express its regrets that Dr. Shelby could not be present during the 1959 meeting.

(Motion was made by Dr. Bennett, seconded, and carried unanimously that the resolutions be adopted and entered in the minutes.)

Director Wheeler:

I don't have any formal statement to make. First of all, I would like to express my appreciation and that of the Directors for the fine presentation of W-1 that was made before them yesterday afternoon and last night. Those are things that are necessary from time to time to bring folks up to date. I was particularly interested in some of the points raised relative to the future or long-range objectives of W-1. Obviously, we cannot stand still, and also, equally obviously, we cannot short-cut everything we are doing now in our anxiety to pursue new leads or enter new fields. It is a proposition of keeping intact the sound research that is currently in operation as well as having a forward look at the whole area of beef cattle research in the long-range view.

I was interested in Dr. Clark's summation of some of the points he considered worthy of pursuit in the future. No research project is permanently endowed, and that is the reason it is well to think about where we are going. The fact that W-1 is of the type of research it is gives it the basis for the continued support it has in comparison with the short-time projects which wind up in four or five years or less. But we must be aware of our progress and where we are going. This we must be objective about in terms of long-range objectives. Some think Directors are impatient and anxious to terminate money so they can support other projects. That is not the primary purpose of calling for reviews or evaluations. The primary purpose of the request of the Directors last fall for a ten-year review or summary of your accomplishments was not to see whether or not we could cut so many dollars off W-1. The purpose was to inform the Directors, State Experiment Stations Division representatives and others as well as ourselves just what ground you have plowed and with what results, and to see what should be done in the way of shoring up our completed work, adding some validity to present work, or attacking new problems.

It is my responsibility to relay this ten-year summary request to you. I was reminded at the meeting of the Directors in March that this had not been accomplished. I said, "Give us time. It takes some time to review ten years." I hope it will be forthcoming on the date set. (So, may I ask, "Just where do we stand? Dr. Bogart: "We just about have it.")

We have plowed a lot of ground over the years. Much of it has been profitable. Some of you have experienced some disappointments in work that has not been as productive as we hoped. The summary will naturally place the standing of W-1 in the minds of those who raised some questions about it in a much better position.

It is probably wise that every regional project has its critics, not only from within but also from without. You may not share this philosophy. Regional research is continuously under the microscope of critics as part of the program of expenditure of public funds for research, so we do have to speak of reporting in terms of major accomplishments of a project as a whole. Many people do not ever see all your technical papers. They are shared by your own colleagues and to some extent get disseminated out through extension channels and other means. But when a ten-year report is prepared, it serves to bind together the work of the period.

Some of you, I know, were disappointed about the cut in the W-1 allotment that was made last March at the Western Directors' meeting. I circulated the statement in March.

I have to be completely frank with you. W-1 was not the only project which had to give a little in terms of fund allotments. We had to leave all the W projects as they were, and we had no new funds assured for new projects which have seemed to be worthy. Some of you have shared in the preparation of

these new projects. With no new funds at that time, and again currently, we felt we had to make some adjustment in the allotments, with the result that I said to you in a memorandum that if any new funds were available the cut would not be made, and that this cut of \$4,800 was not one which would be considered necessarily a permanent one or would have any permanent basis by construction or interpretation. I became insistent on that when it became apparent that we all had to do a little sharing. In the minutes it will be evident that the cut does not carry with it any permanent obligation or commitment. That I did hoping Congress would come through with some increase in the payments to the states. This was not forthcoming, as you know. We are apparently in an era of some hostility, with the result that each of the regional projects is receiving somewhat less than they had before.

I am not going to make the assumption, gentlemen, that we are going to take up the slack. I am not unmindful that in most stations there are ways and means of equalizing these allotments to some extent. What bothers me from time to time is the common reaction on the part of some technical committee people. Once in awhile somebody comes in and says, "Unless I get more money I cannot run my project," as though R. & M. are the only funds available on which to run a project. I am not using this argument as a means of getting out from under this project--that was faced by us this spring in making this reduction. All I am saying is that there are in most stations ways and means whereby small amounts of research funds can be picked up. Most of you in W-1 have found means of meeting costs in one way or another.

May I say I am well pleased with this project. This is my present belief. I hope it is shared by the Western Directors. I think the program yesterday was definitely a step in the right direction of giving the Directors the entire picture of the regional project, the state contributing projects, the accomplishments, and it will probably do much to hold the interest and support we must have in the end. We must, however, always be alert to our obligation to keep our research progressive and never to be complacent, because complacency is one of those things that usually is rewarded by somebody taking something away from you.

That is all, Mr. Chairman. I want to thank the Oregon group for the hospitality extended to me as well as to the rest of the group.

Dr. Stonaker:

Have you any suggestion, Dr. Wheeler, in this matter of the possibilities of other sources of funds that could be directed into this work? Everyone can see that it is at the point now where it is going to become more expensive rather than less as a result of growth and maturity, and the necessity of finding out answers to questions that earlier research has developed. Do you see any glimmer of opportunity that we may not be aware of?

Dr. Wheeler:

My answer is based on several assumptions negative in the sense that they are not exactly opportunistic.

My first assumption is that agricultural research is under the gun. I do not think it is wholly an assumption. This is not only at the Federal level. This is at a growing degree in many states--our state for one. We are experiencing this. It is possibly a by-product of the growing power of certain people. It is a lack of understanding of the benefits that sell agricultural research. But as I visualize this in the next few years we are going to be hard pressed to get really substantial financial support for research relating to production. If we make that assumption we are going to have to look for other means to give a degree of financial support to basic research--basic genetics, basic physiology, all that. Where are we to find that support if we assume it is not coming through state or Federal channels?

One thing encourages me. NIH had its fund allotment increased by over a million dollars, and NIH is making grants for research in biology. I don't see why some of the phases of research we are thinking about in W-1 wouldn't come under some of these grants. Why are we in agriculture so relatively slow to break through that area that seems already to have been penetrated by the zoologists, entomologists, physiologists, etc.? It seems to me we are dealing with basic research that would qualify just as well as any other area that receives very favorable support from such funds.

I would think very seriously of placing proposals with basic approaches--others will not qualify--with such institutions. We were told this afternoon that one of the research arms of the armed forces had made a grant that reaches over into agriculture. It seems almost fantastic that here we are almost scrounging for funds and others are able to get generous grants.

We have not watched the channels for funds for basic research in agriculture. We have pretty well covered the practical field. Now we must get back to basic research. When you get into the basic way of things I have a feeling we can interest some of these pretty well financed organizations if we will place our proposals so that they reflect the basic approach. But if we try to prepare them as a disguise for something else, we are not going to get to first base.

Dr. Pahnish:

Are you implying that we should shift over more to small animal work?

Dr. Wheeler:

No, not necessarily.

Dr. Pahnish:

NIH have just flatly rejected any research with beef animals for the subject. The attitude of the representatives has been that if we use farm animals then we are dealing with applied research. If small animals are used it becomes basic research.

Dr. Wheeler:

Perhaps a project that would be approved by NIH or NSF could in its application, if it is not tied directly to W-1, could well be integrated with it. If it is necessary to team up with the anatomists, zoologists, physiologists, whoever they may be, that is smart.

Dr. Clark:

Some of the stations are doing that now.

Dr. Wheeler:

Let's not maintain our position as beef cattle research men to that point where we starve together in the process.

I am going to have to say again, I am afraid we are in for some slim rations so far as public money through regular channels is concerned.

Dr. Bogart:

It looks like it will come through grants.

Dr. Warwick:

Some states are financing agricultural research by an assessment on a bag of fertilizer, or feed, etc.

Dr. Wheeler:

I don't know how general it is. I have not had much success in convincing these commodity groups. You just don't sell that bill of goods to a state legislature. I find it very difficult in dealing with project research or research of a long-range type to get our public critics very excited about anything but, "Why can't we wind this up?"

Dr. Bogart:

Thank you very much, Dr. Wheeler.

We have two visitors with us in the persons of Dr. Keith Gregory, Coordinator of NC-1, and Dr. C. M. Kincaid, Coordinator of S-10. Perhaps Dr. Gregory has something to say to us.

Dr. Keith Gregory:

I would like to express my appreciation to the W-1 Committee for the opportunity of attending this meeting. I have enjoyed your sessions very much. I would like to express my appreciation to you and to the Oregon people for the hospitality shown.

Our NC-1 Technical Committee meeting is July 23 and 24, at Iowa State College. We would like to have any of you who can attend our meeting this year or any year that you can be with us.

As Dr. Wheeler pointed out, we have just completed a summary and justification statement for NC-1 which is brief and deals to an extent in generalities, but perhaps you can get most of what I could say from that statement.

Some of the things in general which we are concerned with:

The three areas of measurements of traits of economic value--fertility, carcass quality, and efficiency--we are very much concerned with and likewise could benefit from more sessions in this general area getting new ideas, exchanging ideas as to what the approach might be. We are going to devote more thought and more attention to that area.

As to measuring results in these areas, we have some new projects, one at Purdue.

We have some information ready for analysis in NC-1.

Several of our projects are being revised at the present time.

Our work at Fort Robinson has been completely revised. We do have a rather extensive heterosis experiment under way there involving the three British breeds--275 females in this experiment using four bulls each year of each of the breeds, inbred and outbred bulls. Also, we have a small heterosis experiment at Ohio involving the Charollais x Hereford cross and we will be separating those groups and subjecting them to two management regimes--in a broad sense, an environment-genetic interaction.

The work in general: Selection within large lines at Fort Robinson for specific traits, measurement of correlated responses in other traits, and of course the parameter estimates--we hope to be able to get accurate estimates of genetic correlations. We think we will be able to get reasonably good estimates of heterosis effect.

We don't have much work that will yield genetic-environmental interactions. We do have some at Iowa.

Controls for selection experiments concern us very much; also, the frozen semen possibility is one we are very much interested in, and we would like

to see it explored further possibly on a national basis whereby we could see what we might be able to derive from that general area as control possibilities.

In the way of new work, most is dealt with in our summary and justification statement.

Dwarfism is being continued on a somewhat reduced scale. Four stations will continue some of this work.

Dr. Cobb:

At these stations where sires have been used in different years, have they estimated sire-by-year interactions?

Dr. Gregory:

One of the real problems is we would like to be able to get at our data a little faster.

Dr. Bogart:

Dr. Kincaid, will you tell us about your work in S-10?

Dr. Kincaid:

I would like to take this opportunity to do a little advertising, to say that our Technical Committee will meet at Tifton, Georgia, August 31 and September 1 and 2. If you would come you would have an opportunity to see some of the work that is going on, particularly some of the crossing work and different kinds of cattle being used. I think we had eleven groups, breeds, or kinds of cattle that we were breeding inter se this last year.

We are trying a number of different kinds and types of cattle in the Southern region, particularly in the Gulf Coast and Florida.

One of the things we are going into this coming Technical Committee meeting is to take a look at some of our carcass data, particularly as to adding quality.

There is a trend in the beef cattle breeding work in the Southern Region to tie our breeding work in a little closer with the meats work. We have given the meats people some very good material, and at the same time they can give us some very good information we need, too. I hope we may come up with some way of evaluating the animal while it is still alive for carcass quality.

We are doing some work at one station with three types, two breeds in each type, and that is taken and used for a test with consumers. It has

demonstrated that you can get good eating beef that is not necessarily very fat.

This matter of general and specific combining ability we are going to take a look at.

Most of the crossbreeding work has been with Brahman type cattle. However, we do some crossing with the British breeds. One has some economic features about it. The foundation cows are obtained by buying calves from feeder calf sales, each calf to come from a different farm, forty calves from each of the three British breeds, coming from 40 different farms. Another feature was that we are using crossbred as well as purebred bulls. Using crossbred to get back-cross and three-way cross calves in the same generation. So these cows are raising first-cross, back-cross, and three-way-cross calves in that experiment. Now, crossbred and straight bred dams will be bred this year. Straight bred and crossbred bulls will be used on these cows--crossbred bulls on straight bred cows, etc. This is at Virginia.

Dr. Bogart:

Dr. R. A. Damon of Biometrical Services of the Agricultural Research Service is with us.

Dr. Damon:

I would like to say that it has been a pleasure to be here. I certainly have enjoyed this, listening to all the papers and hearing the work that is going on, and I particularly enjoyed the salmon barbecue. I want to pass on Dr. Harvey's greetings to you all.

Dr. Burris:

It is always a pleasure to come back to one's own alma mater.

I do want to comment particularly on the presence of Dr. Keith Gregory, Dr. Kincaid, and Dr. Damon. The attendance of representatives from other regions and other agencies not only makes the W-1 project better, but helps to coordinate the entire project.

I would like to remind the men whose projects were revised and accepted here by the Technical Committee that those should be sent in to us by their Directors for recording as contributing projects.

I expressed myself, and probably the sentiments of our office, about keeping projects as current as possible. We in no way want to tie anyone's hands, but quite often questions come in to our office about what is going on, and I am in a fairly good position to tell them about what is happening in W-1. But if I am not at the office someone has to check the records and if it is not in the records they are lost.

I did check the stations this year to find out what they were doing, and at present things are quite up to date.

Perhaps last year I forgot to pass on to you some comments of the Committee of Nine. Each spring at the February meeting of the Committee of Nine all regional projects are reviewed by the review committee of the Committee of Nine and certain comments about the progress that is being made are put in the minutes. Usually no comments are made if everything is going well, but if things are not going well there are certainly reactions.

However, at the February 1958 meeting of the Committee of Nine they went on record with a comment about W-1, "The regional coordinator is highly commended for his contribution to the project," according to the record for accomplishments under his project.

I give you this as a pat on the back. Maybe we can stand that, if we don't become complacent.

Two things came up there. One was the effective cooperative work with the Air Force at Denver in the IBM computing work. I was rather enthusiastic when the cost of \$600 came up as the cost to the Denver office on an annual basis.

The other thing was the Literature Review. This was brought to the attention of the Committee of Nine and quite a favorable reaction was obtained. I am like everyone else, I think that is a good thing. I don't know whether we are the people to do it or not, but it is helpful to research workers.

Our position is one of attempting to help you in any way we can, and any requests you direct to me I will give my personal attention.

Dr. Bogart:

I would like to express the feelings of this Committee to the other regional coordinators. We have expressed before and continue to express great appreciation for the exchange of publications. We try to send to your technical committees any publications that we put out, and we certainly appreciate any manuscripts we get from you. We think that is an extremely helpful thing.

Dr. Warwick, I am sure you have something to say to the group.

Dr. Warwick:

I will try to be brief.

There are two things in the nature of over-all business.

Last year this group passed a resolution which asked me to contact the various purebred associations regarding relaxing regulations to meet the needs of research herds. The other two regions passed similar resolutions. We followed up on that and contacted the associations. The Brahman association indicated they will cooperate with us on this. The other associations said, "No." That is the status of that.

I would assume there is still opportunity for individual stations to make an approach and they might have a chance to get approval on it.

Also, a resolution was passed to the effect that it was hoped that Federal Extension Service in developing performance testing programs would attempt to make them as uniform as possible from state to state and plans were to be sent to Mr. Bell and myself for approval. Complete uniformity will never be achieved, but I think a great deal will be accomplished in that direction. Two states have adopted almost in toto the regulations of another state. There is still quite a little diversity, and perhaps rightly so in many cases. Over the years we will find out how much similarity there can rightly be and how many differences we must keep.

Someone raised the question whether ARS might be in a position to supply funds for small animal research that supplements our cattle breeding project. I told him that might be possible, but it would have to come away from some other phase of the work. I think Dr. Wheeler put the fund situation very well.

I think with the exception of \$50,000 for dwarfism research and increases that have largely covered salary increases that have come to Federal employees over the years, with those exceptions there have been no increases for beef cattle breeding research in approximately ten years, and we all know what has happened to all of our costs over the years. Inflation has occurred so while we have the same number of dollars they don't go as far as they used to.

Your list of publications is a very imposing one. I wonder if it might not be useful and if it might not bring about just a little better reaction if they could be divided into scientific, theses, abstracts, popular publications, and list them as such. That is a possible suggestion for your ten-year report.

The last item I have in mind is the plan for publishing your ten-year review.

Dr. Bogart:

We had voted last year, you know, to make a review and put it out as a regional publication and the material has been called in and I believe it is in from practically all of the stations. Dr. Clark has the information for putting that together.

Dr. Warwick:

I think it is highly desirable to push ahead and get out the summary publication. It will be very helpful to the project.

Another thing that is minor, I think. We did revise several of the Federal line projects during the past few months, and the other day I got a letter from the Central Project Office. The question was raised as to whether or not there is not a lot of duplication in the Western Region. I think we can look on that as necessary replication instead of duplication, and we will defend the work on that basis. However, in titling your projects, try to be very specific.

Somewhat along the same line, I wonder whether these 53 lines of cattle that are in the process of formation and have been carried in the Western project--and there are some in the other projects, too--whether the time has come for evaluating those lines, finding out the potential, and discarding and doing something else with the facilities the others are taking up. Judging from the work, only a small portion of these lines will ever be useful. We should be continuing the testing and discarding the ones not too useful.

Regarding areas of research and the proper functions of the Technical Committee, I think we all realize there are two approaches that can be taken to the thing. First, the Committee can meet and exchange ideas, and each member or each institution be free to take up the work they are particularly adapted to or can do. That approach has much to commend it and is probably the only realistic approach that can be taken.

The other approach is for the Technical Committee to examine freely the type of research that can be undertaken, then find locations where the research can be done. I don't feel we can go too far in that direction, for we want to allow the individual initiative. However, I wonder about making recommendations through this approach. That is just an idea to kick about.

I am very happy to be here again, and I believe we can say every year that more information is coming out of W-1 than ever did before.

In an effort to keep representatives of each region as well informed as we can of what is going on in the other regions, we are having all three

coordinators at the technical committees on a rotating basis. I wish we could have all three attend all meetings, but we would have trouble getting that much travel authorized.

Two or three people have expressed the idea to me that they wish the committee could meet with one or both of the other technical committees some time. I believe it was done once. It would be expensive. This group might want to give a little attention to whether or not they would like to think about it in the future.

That is all I have to mention now.

(Dr. Clark then commented on his reactions during the past year when he had full opportunity to look back on the work programs we have been pursuing and reflect on how we could improve our total program. He expressed his appreciation for the continued evidence of real team spirit that has typified W-1 from its inception, and for the opportunity presented to work with people.)

Dr. Bogart:

The Oregon station has enjoyed very much having you here. We have enjoyed your comments relative to our efforts, and we hope that you will come back. This is good vacation country if you want to spend a vacation, but you might come in and visit us a little on the side. We extend you a hearty welcome at all times.

Perhaps Dr. Bennett, the new Chairman, has something to say.

Dr. Bennett:

I think we have had full sessions both days and have accomplished much.

I am very happy to look forward to having you come to Utah next year. I hope we can control the weather and other factors, and make it as pleasant as it has been here this year.

Meeting adjourned.
